DOCUMENT RESUME

ED 041 107 VT 010 246

AUTHOR	Schwalm, George H.
TITLE	Transportable Industrial Arts Learning Laboratories. Evaluation Report, 1968-1969. ESEA Title III Project.
INSTITUTION	San Lorenzo Unified School District, Calif.
PUB DATE	69
NOTE	132p.
EDRS PRICE	EDRS Price MF-$0.75 HC-$6.70
DESCRIPTORS	Curriculum Evaluation, *Educational Research, *Educational Specifications, Facility Expansion, Facility Guidelines, *Facility Utilization Research, Grade 8, *Industrial Arts, *Mobile Laboratories, Program Evaluation, Student Evaluation, Teacher Evaluation
IDENTIFIERS	*Elementary and Secondary Education Act Title III, ESEA Title III, San Lorenzo Unified school District

ABSTRACT

Four prefabricated mobile units housing specialized industrial arts equipment were rotated among four junior high schools in this project, which was designed to improve eighth grade student performance and teaching techniques. The demonstration group showed significantly greater gains in tool usage, problem solving abilities, consumer knowledge, and general social behavior as indicated by pre-and posttests and instructor ratings. Teachers, who received workshop sessions and guided practice in planning instructional sequences, were judged on demonstrated ability in pre- and post-workshop assignments and were generally improved. The transportable laboratories were an unqualified success. Recommendations include: (1) greater emphasis upon consumer education and vocational guidance activities, (2) extension of industrial arts to Grade 7, (3) improvement in the status of industrial arts through improved instruction, and (4) continued use of the transportable units as a necessary functional part of the total program. Statistical tables, a copy of teacher made pre- and posttests, educational specifications for the facilities, and a course of study for each area are appended. This research was funded under Title III of the Elementary Secondary Education Act. (CD)

ED041107

OCT 23 1969

①

ESEA TITLE III PROJECT

TRANSPORTABLE INDUSTRIAL ARTS LEARNING LABORATORIES

EVALUATION REPORT

1968-1969

San Lorenzo Unified School District

Paul D. Ehret, Superintendent

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION
THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL OFFICE OF EDUCATION POSITION OR POLICY.

Prepared by

George H. Schwalm

Project Director

VT010246

SAN LORENZO UNIFIED SCHOOL DISTRICT
Division of Instruction

TRANSPORTABLE INDUSTRIAL ARTS LEARNING LABORATORIES

EVALUATION REPORT

TITLE III

Objectives

Instruction

To improve junior high school student performance in industrial arts relative to usage of tools, machines and products, problem solving abilities, consumer knowledge, social behavior and occupational understanding.

Inservice

To improve techniques of industrial arts teachers relative to identifying and deriving student behavioral outcomes, planning activities to bring about the desired behavioral outcomes and developing criteria for student terminal performance.

Transportable Laboratories

To test the feasibility of using transportable facilities in industrial arts relative to transportability, cost, learning environment, code requirements and adaptability to other applications.

Activities

Instruction

Instruction was provided in six areas: drafting, graphic arts, electricity, metalworking, power mechanics and woodworking. The drafting and woodworking classes were housed in existing structures and did not rotate between schools. The other four areas were housed in the transportable structures. Each instructional area was of nine weeks duration with students electing two or more areas. Emphasis was focused upon the development of understanding rather than manipulative skill. The student project method was used as a motivating force and centered upon problem solving techniques, research and experimentation and line production activities.

Inservice

Workshop sessions and staff meetings under the direction of the project manager were held prior to and during the school year to improve teacher expertise in curriculum planning and development. Guided practice was provided in the development of objectives and planning and sequencing of instructional units. Course outlines and supportive lesson plans were developed for each instructional area.

VT010246

Transportable Laboratories

A stationary prefabricated 40 x 36 foot structure housing the classroom area and work stations was erected at each of the four junior high schools. Four additional 10 x 36 foot mobile structures, housing the specialized equipment for each of the four new areas - metalworking, graphic arts, electronics and power mechanics - were attached to the stationary structures. Each nine weeks the equipment capsules were detached and rotated between the four sites.

Evaluation Strategy

Instruction

All 1968-1969 eighth grade boys were pre and post tested on usage of tools, machines and products, problem solving abilities and consumer knowledge. Tests of statistical significance (see Appendix A) were employed to ascertain whether significant gains were achieved.

All 1967-1968 eighth grade boys, not having received the special program, were selected as the comparison group and were post tested with the same test battery. Tests of statistical significance were employed to ascertain whether or not there was a significant increase as a result of the special program.

Since the 1967-1968 group under the old program received instruction in only two shop areas - woodworking and drafting, no attempt was made to make a comparison of usage of tools, machines and products in the areas of power mechanics, electricity, graphic arts and metals.

Teacher-made tests (see Appendix B) were used for usage of tools, machines and products and for consumer knowledge.

A standardized Test of Mechanical Comprehension, Form AA, was used for problem solving abilities.

Homogeneity of students in the 1967-1968 old program and the 1968-1969 special program was statistically compared, using SAT scores.

Improvement in social behavior was derived from a locally devised rating scale at the conclusion of the program. Ratings were made by junior high principals, vice principals and counselors.

Occupational understanding was rated by the project manager using structured interview techniques with each instructor.

Inservice

Comparisons were made of pre and post workshop assignments by district office curriculum consultants. Teachers were rated on their demonstrated ability to write objectives in behavioral form to develop relevant, sequential instructional units. Ratings are reported as consensus of opinion.

Transportable Laboratories

A descriptive analysis of transportability based on actual performance is reported under the heading "results."

A comparative cost of traditional vs transportable facilities is included. Costs reflected for transportables are bid figures. Costs of traditional facilities were derived from architects on the planning committee (see Table 4-5).

The suitability of transportable facilities for housing industrial arts classes is presented by means of a comparison of educational specifications (see Appendix C).

Code requirements and the adaptability to other applications are discussed under "results."

Results

Instruction

Means (M) for pre and post test scores and tests of statistical significance for mean differences are presented in Table 2 (see Appendix A).

The data shows significant gains in usage of tools, machines and products, problem solving abilities and consumer knowledge as a whole. Highly significant gains were made in problem solving abilities. With the exception of consumer knowledge, significant greater gains were made by the demonstration group than by the comparison group.

The results of the social behavior ratings are presented in Table 3.

Item Number 1 - general social behavior - shows a mean (M) discernable change of 2.8 on the 5-point scale. Program facilities were rated as contributing most to this change. Positive change was less discernable in tardiness, attendance and referral to counselors. Performance in other classes was rated as discernable. On the whole, all ratings were positive discernable.

Occupational understanding was informally rated by each classroom instructor. Each instructor was interviewed by the project manager and consensus of opinion indicated that students did, in fact, make use of guidance materials in each laboratory and exhibited an increasing awareness of the occupations represented in each shop area. Each instructor felt that the new shop experiences had a positive effect on vocational readiness.

Data from the SAT scores for the demonstration and comparison groups indicate that as a whole the difference between groups would not have a significant effect upon the statistical significance of the gains as a result of the new program. Looking at each subtest separately, differences were significant in language at the .01 and in arithmetic concepts at the .0005 levels of probability as presented in Table 1 (see Appendix A).

Inservice

Preceding inservice training each of the six instructors was asked to submit an innovative 9-week course outline for his instructional area. An examination of the submitted course outlines revealed little or no difference from traditional outlines found in many State Department of Education curriculum guides. Interviews with the instructors revealed a paucity of prior knowledge concerning behavioral objectives, unit outlining, sequencing, content selection and criterion examination preparation. There appeared to be little correlation between age of the instructor and years of teaching and his abilities in curriculum design. The only noteworthy exception was the electronics instructor who had completed the teacher training program the preceding year. Using Mager's book on Preparing Instructional Objectives as a reference, the project manager devoted many hours of direct assistance to each instructor. The revised course outlines (see Appendix D), while not optional, do approach the criteria specified in the project plan.

Transportable Laboratories

(See Drawings, Appendix C) Distances between the four junior high schools range from 1 to 2 miles. Most streets on the route are 2-lane, 40 to 50 feet in width, with maximum overpass clearance of 14'6". (Overall capsule height is 14'0"). Traffic is from medium to heavy. Moves are made between the hours of 8 to 5 on either a Friday or Saturday, dependent upon whether school is in session.

Advance preparations for moving the overall 10 x 44 foot capsule units consist of removing roof, wall and floor caps, disconnecting electrical service and removing four bolts attaching the capsule to the permanent structure. The tongue of the capsule unit is elevated to receive the towing vehicle. All four capsule moves are completed in one day by two towing trucks with drivers, well within the planned criteria. Two district maintenance employees assist in the moves. The open sides are covered with tarps during the moves. No special lashing of equipment is required. There has been no discernable evidence of equipment movement in the three moves to date. Exiting and docking of the capsules is accomplished with ease and no structural damage.

Of a total of 87 educational specifications and recommendations for industrial arts shops (see Appendix C), the transportable laboratories were in or exceeded conformance in 70 out of 75 items (12 not applicable).

Of the 5 "No's" reported:

> Ceiling height was less than the minimum of 12 feet. The actual height ranges from a minimum of 9' 6" to a maximum center clearance of 10' 6" with an average height of 10'. Because of excellent air conditioning and ventilation no discernable discomfort is evident.
>
> Windows were eliminated for security reasons. The absence of windows does not appear to have a negative effect upon the learning environment.
>
> Workbenches with tablet pull-outs and lockers below on both sides, and located in the free area as opposed to exterior wall placement, serve dual purposes as general work and class assembly area.
>
> Sinks with wash facilities are located in the permanent structures. Toilets were not included because of the close proximity to the school plant. Prefab restroom facilities are available from the manufacturer should a need exist.
>
> In lieu of natural lighting, fluorescent fixtures with a minimum of 80 foot-candles at the task level were provided. The lighting system meets the standards of the American Guide for School Lighting.

All structural and mechanical installations conform to both State and Federal code regulations.

The permanent structures as well as the transportable capsules, when docked, rest on concrete foundations.

Each 10' module is rigidly constructed of welded "I", channel and tube beam. Each is a free-standing unit bolted to the foundation and to each other. The capsule unit is of heavier construction designed to support a 10,000 lb. live load.

Replaceable wall panels are finished inside with fabric over 1/2" plywood. Exterior finish is heavy gauge enameled sheet metal.

Floors are constructed of 1 1/8" plywood with vinyl tile surface.

Ceilings are acoustical tile.

The structure is completely insulated and all wiring, ductwork and piping is concealed.

The electrical system incorporates a centralized public address system, clock, fire alarm and telephone, all connected to the main office of the school.

The mechanical system includes plumbing, heating and air conditioning. Cold water and natural gas is piped. Hot water is obtained by means of an under the sink electric heater. Waste drains to the sanitary system.

Heating, air conditioning and ventilating hoods are roof mounted. The combination system normally supplies 20% outside air with capabilities for 100% outside air. Air conditioning provides a cooling capacity of not less than 4 B.T.U. per cubic foot of room capacity with a heating capacity of not less than 6 B.T.U. per cubic foot of room volume.

The aesthetic appearance is of a low profile unified structure. Depressing the capsule running gear in the recessed ramp reduced the distance from ground level to floor height by 27 inches. The capsule and the permanent structure appear as one, having no breaks in wall or roof lines.

The adaptability of this plan to other situations is limitless. The size of the structure itself can be increased by any number of 10' modules. Capsules could be placed at both ends of the permanent structure to increase flexibility. Rotation of capsules could be achieved with a minimum of two to any number. The capsule concept can be used in almost any educational program desiring to make full use of specialized equipment.

From a cost comparison standpoint (see Tables 4-5), traditional facilities with site work, architect's fee and equipment exceed the transportable cost by $57,295.00. To achieve the diversity of program offerings at each of four sites as provided in this project, the traditional costs would exceed the transportable costs by $832,657.00.

Conclusion

Instruction

The instructional program was successful in that the demonstration group showed significant gains in all categories. The effect of the facilities and equipment contributed as much, if not more, than any other factor to the attitude of the students toward the instruction. Since there was no difference in the selection of the groups, and no prior instruction for the groups, the significant difference in end performance can only be attributed to the special program.

Inservice

The inservice training program has had a positive effect upon the instructional staff as evidenced by the course outlines and in the interim evaluation report by the San Jose State Team (see Appendix E). Prior to inservice training the instructors perceived the mechanics of curriculum development as rote copying of State guides. Course objectives were patterned after eternal verities handed down from teacher training institutions. Methodology was based on such time honored axioms as "learning by doing" and "Proceeding from the simple to the complex." To break the traditional emphasis upon manipulative skill development as opposed to conceptualized learning approaches was like challenging "motherhood, the flag and apple pie." Progress, though slow, is apparent.

Transportable Laboratories

All aspects of this operation have exceeded our expectations. The transportability of the capsules, educational environment and cost-wise, have proven to be an unqualified success.

Recommendations

Instruction

Results of this evaluation indicate that the objectives are being successfully fulfilled. However, greater emphasis should be placed upon consumer education and vocational guidance activities. The importance of developing vocational readiness dictates that this should be a two-year program extending downward to the 7th grade.

Inservice

While positive professional growth is evident in this area, more emphasis is needed if the quality of instruction is to be improved to the extent that industrial arts receives the status accorded the other disciplines.

Transportable Laboratories

The success of the transportable concept is aptly stated by the San Jose State Team: "That capsule-transportable units have a valid and definite place in the instructional dynamic for industrial arts and other learning environments." The continued use of the transportable units is a necessary functional part of the total program.

APPENDIX "A"

TABLES 1 - 5

TABLE I

STATISTICAL COMPARISON OF HOMOGENEITY OF DEMONSTRATION VS., COMPARISON GROUP

TEST		COMPARISON GROUP (1967-68 8th. Gr.)	DEMONSTRATION GROUP (1968-69 8th. Gr.)	z	P<
Paragraph Meaning	M (SD) (N)	27.09 (10.83) (1220)	26.81 (11.22) (1224)	<1	N.S.
Spelling	M (SD) (N)	24.39 (10.03) (1220)	24.34 (9.88) (1223)	<1	N.S.
Language	M (SD) (N)	83.18 (17.80) (1225)	85.35 (17.94) (1223)	3.0	<.01
Arithmatic Computation	M (SD) (N)	15.24 (6.71) (1220)	15.53 (6.88) (1223)	1.0	N.S.
Arithmatic Concepts	M (SD) (N)	15.48 (6.68) (1221)	16.28 (6.59) (1231)	3.9	<.0005
Arithmatic Applications	M (SD) (N)	13.38 (4.97) (1220)	13.64 (4.85) (1226)	1.3	N.S.

TABLE II

MEANS (M) FOR PRE AND POST-TESTS OF USAGE OF TOOLS, MACHINES AND PRODUCTS, CONSUMER KNOWLEDGE AND PROBLEM SOLVING ABILITIES AND TESTS OF STATISTICAL SIGNIFICANCE FOR DEMONSTRATION AND COMPARISON GROUPS

TEST		DEMONSTRATION GROUP		DIFF.	t	p<	COMPARISON GROUP		DIFF. BET. GROUPS	t	p<
		PRE-TEST	POST-TEST				POST-TEST				
Problem Solving	M (SD) (N)	26.5 (8.8) (338)	30.6 (9.6) (338)	4.1 (8.1) (338)	9.4	.0005	M (SD) (N)	28.7 (10.0) (469)	1.9	2.7	<.005
Consumer Knowledge	M (SD) (N)	10.6 (3.4) (219)	11.2 (4.1) (219)	.6 (4.2) (219)	2.0	.025	M (SD) (N)	11.0 (3.7) (464)	.2	.8	N.S.
Usage of Tools, Machine Production Drafting	M (SD) (N)	11.0 (3.8) (246)	14.9 (5.3) (246)	3.9 (4.5) (246)	13.8	.0005	M (SD) (N)	13.3 (4.5) (446)	1.7	4.3	<.0005
Woodworking	M (SD) (N)	9.0 (2.9) (246)	11.7 (3.4) (246)	2.7 (3.4) (246)	12.5	.0005	M (SD) (N)	11.0 (3.1) (460)	.7	3.2	<.005
Power Mechanics	M (SD) (N)	11.7 (3.0) (327)	13.1 (3.1) (327)	1.4 (3.0) (327)	8.6	.0005					
Electricity	M (SD) (N)	9.5 (3.2) (230)	11.8 (4.0) (230)	2.3 (3.4) (230)	10.0	.0005					
Graphic Arts	M (SD) (N)	10.7 (2.9) (256)	13.6 (3.8) (256)	2.9 (3.6) (256)	12.8	.0005					
Metal Working	M (SD) (N)	10.7 (3.2) (246)	13.3 (3.9) (246)	2.6 (3.8) (246)	10.7	.0005					

TABLE III

MEAN (M) RATINGS OF IMPROVED ATTITUDES OF DEMONSTRATION GROUP (1968-69 EIGHTH GRADE BOYS) AS DISCERNED BY JUNIOR HIGH PRINCIPALS, VICE-PRINCIPALS AND COUNSELORS.

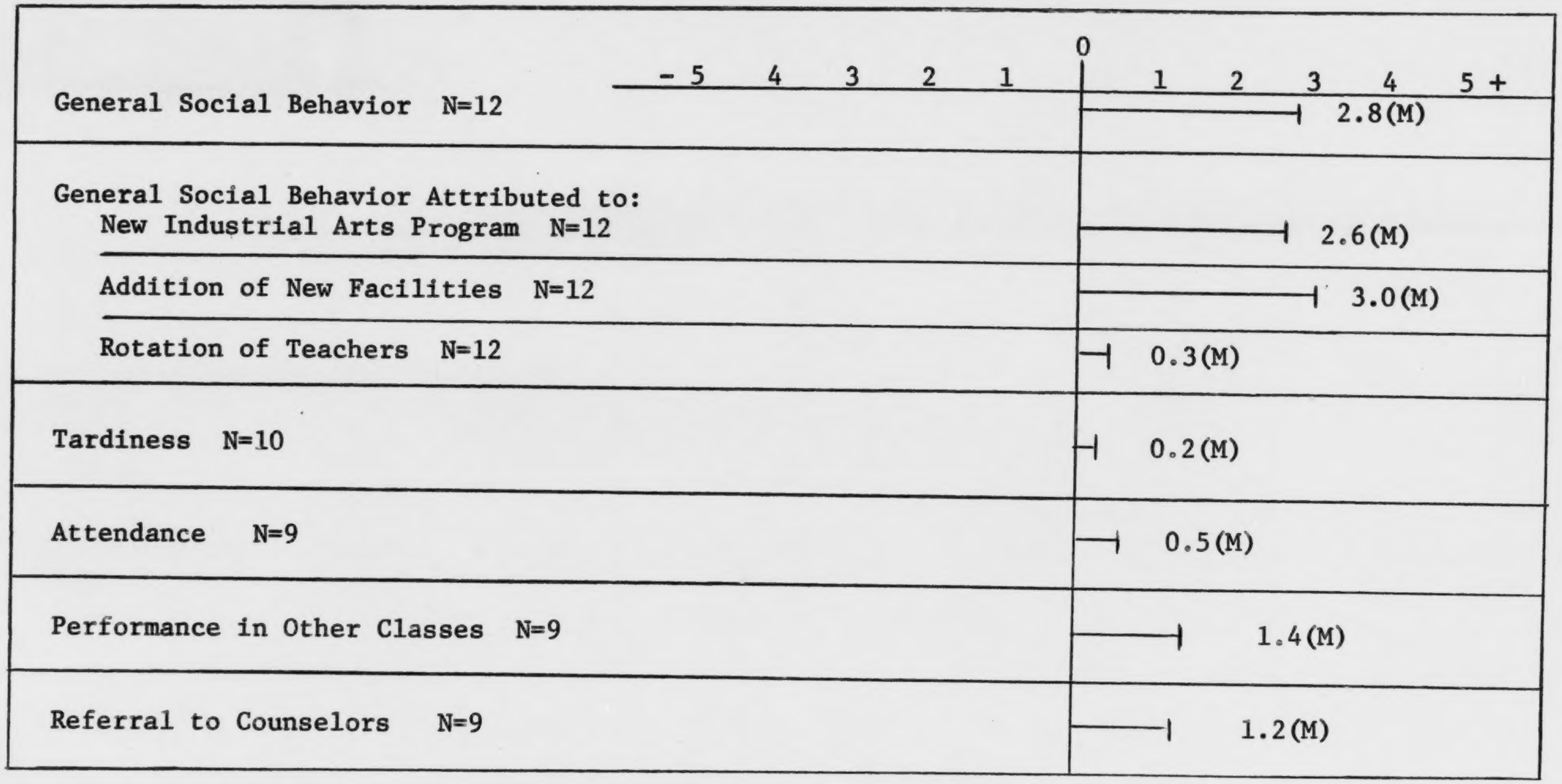


TABLE IV

COST COMPARISON OF TRADITIONAL VS. TRANSPORTABLE FACILITIES AND EQUIPMENT

	FACILITIES	SITE WORK	ARCH. FEE 8%	EQUIP.	MOVING COSTS	TOTAL
Traditional	172,800	24,872	15,814	44,968	- 0 -	258,454
Transportable	119,107	24,872	11,518	44,968	694	201,159
Difference	+53,693	- 0 -	+4,296	- 0 -	694	57,295

TABLE V

COST COMPARISON OF TRADITIONAL VS. TRANSPORTABLE FACILITIES AND EQUIPMENT TO ACHIEVE FOUR UNIT SHOPS AT EACH OF FOUR SITES

	FACILITIES	SITE WORK	ARCH. FEE 8%	EQUIP.	MOVING COSTS	TOTAL
Traditional	691,200	99,488	63,256	179,872	- 0 -	1,033,816
Transportable	119,107	24,872	11,518	44,968	694	201,159
Difference	+572,093	+74,616	+51,738	+134,904	694	832,657

APPENDIX "B"

LOCALLY PREPARED RATING SCALE AND TESTS

TRANSPORTABLE INDUSTRIAL ARTS LABORATORIES EVALUATION

In your opinion, please respond to the following items with regard to the effect the transportable industrial arts laboratories program has had on the social behavior of the students: (please circle the rating number)

RATING SCALE

0 (zero) represents no change or effect.
Right of zero - positive change or effect.
Left of zero - negative change or effect.

The larger the number, the greater or lesser change or effect.

1. The general social behavior of students enrolled in industrial arts classes:

   - 5 4 3 2 1 - 0 + 1 2 3 4 5 +

   If you responded that there was a change in social behavior, please respond to the degree you attribute the change to:

   a. The new industrial arts program:

      - 5 4 3 2 1 - 0 + 1 2 3 4 5 +

   b. Addition of new facilities:

      - 5 4 3 2 1 - 0 + 1 2 3 4 5 +

   c. Rotation of teachers:

      - 5 4 3 2 1 - 0 + 1 2 3 4 5 +

2. What effect has the program had on reflecting changes in attitudes in the following areas:

   a. Tardiness: - 5 4 3 2 1 - 0 + 1 2 3 4 5 +

   b. Attendance: - 5 4 3 2 1 - 0 + 1 2 3 4 5 +

   c. Performance in other classes: - 5 4 3 2 1 - 0 + 1 2 3 4 5 +

   d. Referral to counselors: - 5 4 3 2 1 - 0 + 1 2 3 4 5 +

3. Would you recommend: (check one)

   ☐ Maintaining the present program

   ☐ Increasing the present program

   ☐ Decreasing the present program

SAN LORENZO UNIFIED SCHOOL DISTRICT
Division of Instruction

CONSUMER KNOWLEDGE

1. A stereo system that has solid state components is made up of:

   (a) tube circuits
   (b) transistor circuits
   (c) tube and transistor circuits
   (d) series circuits

2. The finest quality top for a woodworking bench is:

   (a) one-piece construction
   (b) core construction
   (c) veneer construction
   (d) laminate construction

3. If you were purchasing wood to make a shelf, which of the following would be most expensive:

   (a) walnut
   (b) pine
   (c) fir
   (d) mahogany

4. The kitchen cabinets in a new model home are a rich brown color. They are probably:

   (a) walnut
   (b) birch
   (c) ash that has been stained
   (d) knotty pine

5. In equipping a home workshop where the majority of cutting would be sawing boards to length and sawing plywood, the best hand saw to have would be:

   (a) a rip saw
   (b) a combination saw
   (c) a hack saw
   (d) a cross-cut saw

6. Which of the following finishes is best suited for outdoor purposes, such as a bird house or water skis:

   (a) lacquer
   (b) deft
   (c) shellac
   (d) spar varnish

7. For foundation sills, or wood that is in contact with the ground, or other uses where there is concern for rotting, the best wood to use is:

   (a) sugar pine
   (b) redwood
   (c) Douglas fir
   (d) red oak

8. If you were to buy one wrench for general purposes, your best buy would be:

   (a) an open-end wrench
   (b) a closed-end wrench
   (c) a socket wrench
   (d) an adjustable end wrench

9. You are given a job that involves cutting angle iron; the saw you would use is:

   (a) a hack saw
   (b) a cross-cut saw
   (c) a rip saw
   (d) a coping saw

10. You are involved in installing a water line using copper pipe and fittings. The material used to fasten the pipe to the fittings is:

(a) zinc
(b) sal ammoniac
(c) brassing rod
(d) resin-core solder

11. If you were making a project that involved soldering, which of the following wouldn't you use:

(a) copper
(b) aluminum
(c) brass
(d) tin

12. Which sports car would be the most economical to purchase:

(a) custom made
(b) mass produced

13. You are buying a sander for home use. The best type to buy would be:

(a) a disc sander
(b) a belt sander
(c) a portable sander
(d) a pedestal sander

14. We have two bowls - one is die-stamped and one is hand made. Which bowl do you think more people could afford to buy?

(a) the die-stamped bowl
(b) the hand made bowl

15. If you were to purchase twelve quarts of oil, the best buy would be:

(a) 48 pints
(b) 12 quarts
(c) 3 gallons

16. As a manager of a transportation company, you are concerned with the cost of fuel. Which fuel is least expensive:

(a) gasoline
(b) diesel
(c) kerosene
(d) atomic fuel

17. To avoid electrical shocks from power tools, such as a sander or saber saw, they should:

(a) have a ground wire
(b) run on 220 volts
(c) be hot wired
(d) be wired in series

18. You are campaign manager for a "Junior League Queen" contest. As such, you are ordering printed posters. The cost of printed material is highest when:

(a) a single color is used
(b) two colors are used
(c) three colors are used
(d) four colors are used

19. In your print shop, you are printing advertisements. You are concerned with keeping costs as low as possible. The least expensive paper to use is:

(a) newsprint
(b) bond
(c) Tympan
(d) French wax paper

20. You are purchasing an electronic test instrument. A quality test instrument may have a feature that prevents damaging due to overloads. This feature is:

(a) a capacitor
(b) a resistor
(c) an ohm
(d) a fuse

21. You have just connected a twelve-volt light bulb to a six-volt battery. The bulb:

(a) burns dim
(b) burns bright
(c) burns a very short time
(d) does not burn

22. You are wiring a new plug outlet in your garage. You are using a two-conductor wire. The "hot" wire is:

(a) green
(b) blue
(c) copper
(d) black

23. The big day has arrived and you are having your wedding invitations printed. The printing process for such an occasion would be:

(a) offset
(b) engraved
(c) silk screen
(d) block print

24. To power your "go cart", you have a Briggs and Stratton engine. This is:

(a) a Wrankle engine
(b) a four-cycle engine
(c) a turbine engine
(d) a jet propulsion engine

25. You are selecting sprockets for your bicycle. You want a 3-to-1 ratio; that is, for one turn of the pedal, the wheel will revolve three times. The sprocket on the pedal is 6". The sprocket on the wheel would be:

(a) 2"
(b) 3"
(c) 4"
(d) 6"

SAN LORENZO UNIFIED SCHOOL DISTRICT
Division of Secondary Instruction

JUNIOR HIGH SCHOOL INDUSTRIAL ARTS

TEST OF SUBJECT COMPREHENSION

DRAFTING

Directions:

1. Fill in the requested information on your ANSWER SHEET.
2. Do not write in the question booklet.
3. Write only on the ANSWER SHEET.
4. Mark out the letter which makes the best answer to the statement. DO NOT circle the letter.
5. Look at the Sample Question X, below.
6. The correct answer is "C"; therefore, on your ANSWER SHEET for Sample X, "C" is marked out.
7. Do not open the test booklet until your instructor tells you to do so.

SAMPLE QUESTION X

Nails are driven with:

(a) a plane
(b) a screwdriver
(c) a hammer
(d) a saw

SAN LORENZO UNIFIED SCHOOL DISTRICT
Division of Instruction

DRAFTING

1. Which of the following lines is terminated by an arrowhead:

(a) dimension line (c) hidden line
(b) extension line (d) cutting plane line

2. Which of the following lines describe the shape of an object:

(a) dimension line (c) section line
(b) object line (d) extension line

3. Which of the following is a pictorial drawing:

(a) orthographic (c) pattern
(b) isometric (d) section

4. Which of the following grades of pencil is the softest:

(a) 2H (c) 6H
(b) 4H (d) 9H

5. Which of the following types of drawing uses a vanishing point:

(a) isometric (c) working drawing
(b) orthographic (d) perspective

6. A type of drawing used to show the interior of an object is:

(a) pictorial (c) auxiliary
(b) section (d) revolved

7. Horizontal lines are drawn with a:

(a) scale (c) T-square
(b) triangle (d) combination square

8. Working drawing dimensions are of two groups:

(a) number and group (c) size and reference
(b) size and location (d) direction and location

9. A triangle is a plane bound by three straight lines; the sum of the interior angles is:

(a) 90° (c) 180°
(b) 360° (d) 120°

10. The circumference, or distance around a circle, is:

(a) 90° (c) 150°
(b) 180° (d) 360°

11. A square is a plane bound by four straight lines; the sum of the interior angles is:

(a) 90° (c) 150°
(b) 180° (d) 360°

12. A right angle measures:

(a) 45° (c) 180°
(b) 90° (d) 360°

13. A circle is dimensioned by its:

(a) diameter (c) arc
(b) circumference (d) chord

14. A three-view drawing is called:

(a) an isometric drawing (c) an orthographic drawing
(b) a cabinet drawing (d) an oblique drawing

15. Which of the following lines describes edges that cannot be seen:

(a) dimension line (c) phantom line
(b) extension line (d) hidden line

16. A hexagon is a plane bound by:

(a) four sides (c) six sides
(b) five sides (d) eight sides

17. An octagon is a plane bound by:

(a) four sides (c) six sides
(b) five sides (d) eight sides

18. A pentagon is a plane bound by:

(a) four sides (c) six sides
(b) five sides (d) eight sides

19. A full scale is divided into:

(a) $\frac{1}{32}$ (b) $\frac{1}{16}$ (c) $\frac{1}{8}$ (d) $\frac{1}{4}$

20. A drawing drawn to half-scale would have a scale of:

(a) 1 inch equals 1 inch
(b) $\frac{1}{2}$ inch equals 1 inch
(c) $\frac{1}{4}$ inch equals 1 inch
(d) 1 inch equals $\frac{1}{2}$ inch

21. The dimension that tells the total length of an object is called:

(a) a location dimension
(b) a reference dimension
(c) a total dimension
(d) an overall dimension

22. Vertical lines are drawn with a:

(a) T-square
(b) scale
(c) triangle
(d) protractor

23. Degrees are measured with a:

(a) scale
(b) protractor
(c) T-square
(d) rule

24. The center of a circle is indicated by:

(a) a phantom line
(b) a center line
(c) an extension line
(d) a dimension line

25. The fastest and clearest means of conveying an idea is by:

(a) drawing with instruments
(b) photography
(c) telling someone
(d) freehand sketching

SAN LORENZO UNIFIED SCHOOL DISTRICT
Division of Secondary Instruction

JUNIOR HIGH SCHOOL INDUSTRIAL ARTS

TEST OF SUBJECT COMPREHENSION

ELECTRICITY

Directions:

1. Fill in the requested information on your ANSWER SHEET.

2. Do not write in the question booklet.

3. Write only on the ANSWER SHEET.

4. Mark out the letter which makes the best answer to the statement.
   DO NOT circle the letter.

5. Look at the Sample Question X, below.

6. The correct answer is "C"; therefore, on your ANSWER SHEET for Sample X, "C" is marked out.

7. Do not open the test booklet until your instructor tells you to do so.

SAMPLE QUESTION X

Nails are driven with:

(a) a plane
(b) a screwdriver
(c) a hammer
(d) a saw

SAN LORENZO UNIFIED SCHOOL DISTRICT
Division of Secondary Instruction

ELECTRICITY

1. Which of the following is non-magnetic?

   (a) iron
   (b) steel
   (c) copper
   (d) nickel

2. Like poles

   (a) attract
   (b) have no effect
   (c) repel
   (d) have a pulsating attraction

3. What object is used to protect the current whenever excess current may cause damage to the wire or electrical equipment?

   (a) fuse
   (b) switch
   (c) junction box
   (d) condensor

4. The best conductor of electricity is:

   (a) silver
   (b) gold
   (c) copper
   (d) tungsten

5. A good non-conductor of electricity is:

   (a) iron
   (b) aluminum
   (c) plaster
   (d) tungsten

6. A negatively charged particle of electricity is called:

   (a) an electron
   (b) a proton
   (c) a neutron
   (d) an atom

7. The instrument used to measure current flow is:

   (a) an ammeter
   (b) a voltmeter
   (c) an ohmmeter
   (d) a hydrometer

8. The number of paths offered in a series circuit is:

(a) 1
(b) 2
(c) 2 or more
(d) at least 3

9. The number of paths offered in a parallel circuit is:

(a) 1
(b) 2
(c) 2 or more
(d) at least 3

10. The plug on an extension cord is removed from an outlet by:

(a) pulling on the cord
(b) using a plug rejector
(c) grasping the plug and pulling
(d) whipping it out by snapping the cord

11. The most serious result of attempting to remove a plug from an ungrounded outle while standing on a wet floor could be:

(a) nothing at all
(b) a shock
(c) a burn
(d) death

12. The correct way to connect an ammeter into a circuit is:

(a) in series
(b) in parallel
(c) across the circuit
(d) parallel-series

13. A slot car track runs off a transformer. This type of transformer:

(a) lowers the voltage
(b) increases the voltage
(c) converts from AC to DC
(d) changes nothing

14. Opening and closing circuits is accomplished by:

(a) a transformer
(b) a battery
(c) an insulator
(d) a switch

15. The speed of a slot car is controlled by the flow of current in the circuit. The device used to control the flow of current is:

(a) a conductor
(b) a rheostat
(c) a capacitor
(d) an amplifier

16. Mechanical energy is converted to electrical energy by:

(a) a battery
(b) a transformer
(c) a generator
(d) a rheostat

17. Four light bulbs are connected in series. One light bulb is removed -

(a) three still burn
(b) two still burn
(c) only one still burns
(d) none will burn

18. A device for storing or holding an electrical charge is:

(a) a resistor
(b) a capacitor
(c) a circuit breaker
(d) an armature

19. An extension cord for power equipment has three wires. One wire has green insulation. This wire is called the:

(a) ground wire
(b) hot wire
(c) common wire
(d) return wire

20. A blueprint or mechanical drawing of the electrical parts of a radio is called:

(a) a schematic drawing
(b) a perspective drawing
(c) an orthographic drawing
(d) an isometric drawing

21. The force or pressure that causes electricity to flow is called:

(a) watts
(b) volts
(c) ampere
(d) ohms

22. The amount of current, the number of electrons, flowing through a wire is called:

(a) watts
(b) volts
(c) ampere
(d) ohms

23. Where would you get the most accurate compass reading:

(a) inside a car
(b) inside a building
(c) in a dump
(d) on a football field

24. The number stamped on a fuse indicates:

(a) volts

(b) amperes

(c) watts

(d) ohm

25. The device that operates a light dimmer is a:

(a) rheostat

(b) capacitor

(c) reducer

(d) transformer

SAN LORENZO UNIFIED SCHOOL DISTRICT
Division of Secondary Instruction

JUNIOR HIGH SCHOOL INDUSTRIAL ARTS

TEST OF SUBJECT COMPREHENSION

GRAPHIC ARTS

Directions:

1. Fill in the requested information on your ANSWER SHEET.
2. Do not write in the question booklet.
3. Write only on the ANSWER SHEET.
4. Mark out the letter which makes the best answer to the statement. DO NOT circle the letter.
5. Look at the Sample Question X, below.
6. The correct answer is "C"; therefore, on your ANSWER SHEET for Sample X, "C" is marked out.
7. Do not open the test booklet until your instructor tells you to do so.

SAMPLE QUESTION X

Nails are driven with:

(a) a plane
(b) a screwdriver
(c) a hammer
(d) a saw

SAN LORENZO UNIFIED SCHOOL DISTRICT
Division of Secondary Instruction

GRAPHIC ARTS

1. Slugs are made of:

(a) wood (b) plastic (c) metal (d) cardboard

2. Movable type was invented by:

(a) Benjamin Franklin (c) Johann Gutenberg
(b) William Caxton (d) William Bradford

3. The printing process used to print most newspapers is commonly referred to as:

(a) letterpress printing (c) lithography
(b) intaglio printing (d) mimeograph

4. The art of paper making was first discovered by the:

(a) French (b) Arabs (c) Egyptians (d) Chinese

5. Linoleum block print is a form of:

(a) relief printing (c) lithography
(b) Intaglio printing (d) mimeograph

6. A design or word on a linoleum block must be carved so it appears:

(a) backward or reverse (b) as it will appear when printed

7. Plastic dry-point plates should be engraved with:

(a) acid (c) engraving tools
(b) a sharp pointed tool (d) vilso engraver

8. On a dry-point etch, or engraving, the design is:

(a) below the surface (c) on the surface
(b) above the surface (d) a combination of above and below

9. In order to print four separate colors by the silk screen process, it is necessary to prepare:

(a) one stencil (c) three stencils

(b) two stencils (d) four stencils

10. Lacquer film stencils are adhered to the screen with:

(a) water (c) lacquer thinner

(b) turpentine (d) linseed oil

11. In the silk screening process, the squeegee is used to:

(a) open paint cans (c) force paint through the screen

(b) cover ink cans (d) smooth out the stencil

12. The heading of the type form is usually placed in the chase:

(a) to the top or left (c) bottom or left

(b) to bottom or right (d) to the top or right

13. An imposing surface is:

(a) any flat smooth surface (c) smooth surface of maple

(b) a smooth metal or stone top (d) smooth lead surface

14. The part of a piece of type that prints is the:

(a) body (b) neck (c) feet (d) face

15. A printer's rule is graduated into:

(a) picas (b) points (c) fractions (d) decimals

16. One inch equals:

(a) 3 points (b) 6 points (c) 12 points (d) 72 points

17. The ideal space to use between words set in lower case is:

(a) hair space (c) 3-em space

(b) 5-em space (d) 4-em space

18. Type is read with:

(a) the nick up (c) the groove over

(b) the nick down (d) the feet back

19. The person who sets lines of type for a newspaper is called:

(a) a typesetter (c) a galley setter

(b) a linotype operator (d) a type processor

20. The job entry level for starting out in the graphic arts profession is:

(a) technician (c) supervisor

(b) journeyman (d) apprentice

21. Newspapers are printed on a type of paper called:

(a) railroad board (c) bond

(b) newsprint (d) typan

22. A reem of paper contains:

(a) 100 sheets (c) 500 sheets

(b) 250 sheets (d) 1000 sheets

23. The detailed plan for a printed design is called:

(a) development (c) layout

(b) idea (d) proof

24. Which of the following is the easiest to read:

(a) bold type in mass (c) old English

(b) all capitals (d) capitals and lower case

25. The optical center of an area is:

(a) exactly in the center (c) below the center

(b) above the center (d) to the right of center

SAN LORENZO UNIFIED SCHOOL DISTRICT
Division of Secondary Instruction

JUNIOR HIGH SCHOOL INDUSTRIAL ARTS

TEST OF SUBJECT COMPREHENSION

METALWORKING

Directions:

1. Fill in the requested information on your ANSWER SHEET.

2. Do not write in the question booklet.

3. Write only on the ANSWER SHEET.

4. Mark out the letter which makes the best answer to the statement. DO NOT circle the letter.

5. Look at the Sample Question X, below.

6. The correct answer is "C"; therefore, on your ANSWER SHEET for Sample X, "C" is marked out.

7. Do not open the test booklet until your instructor tells you to do so.

SAMPLE QUESTION X

Nails are driven with:

(a) a plane　　(c) a hammer

(b) a screwdriver　　(d) a saw

SAN LORENZO UNIFIED SCHOOL DISTRICT
Division of Secondary Instruction

METALWORKING

1. Which file is best for removing soft metal, such as aluminum:

   (a) single cut (c) flat

   (b) mill (d) round

2. The process of cutting a hole to hold a flat head screw is called:

   (a) counterboring (c) countersinking

   (b) spot facing (d) reaming

3. Metal may be cut with a:

   (a) hack saw (c) rip saw

   (b) cross-cut saw (d) scroll saw

4. The soldering copper is a tool used to:

   (a) transfer heat (c) melt flux

   (b) melt solder (d) transfer solder

5. External threads are cut with:

   (a) a tap (c) a reamer

   (b) a shear (d) a die

6. The most important reason for equipping files with a handle is:

   (a) to protect the file (c) to improve appearance

   (b) to provide safety (d) it is a school rule

7. Work being drilled on a drill press is:

   (a) held in one hand (c) held in a tool rest

   (b) held in a clamping device (d) held with pliers

8. An example of non-ferrous metal is:

(a) mild steel
(b) tool steel
(c) cast iron
(d) copper

9. Which of the following is not a process of fastening metal together:

(a) pop riveting
(b) welding
(c) annealing
(d) brassing

10. The process of forming metal by pouring molten metal into a mold is:

(a) casting
(b) forging
(c) welding
(d) turning

11. A reasonable clearance between the tool rest and the grinding wheel is:

(a) $\frac{1}{8}$" or less
(b) $\frac{3}{16}$"
(c) $\frac{1}{4}$"
(d) $\frac{5}{16}$" or more

12. Flux is used:

(a) to physically clean the surface
(b) to use less solder
(c) to cause heat penetration
(d) to prevent oxidation

13. The most common hammer used in the metal shop is:

(a) ball peen
(b) claw
(c) raw hide
(d) blacksmith

14. Lines are best drawn on sheet metal with:

(a) a pencil
(b) a scratch awl
(c) a ball point pen
(d) a felt marker

15. Changing metal to a desired shape is called:

(a) forming
(c) treating
(b) fastening
(d) turning

16. The common alloy of a ferrous metal is:

(a) copper
(c) nickel
(b) brass
(d) iron

17. The heat treatment process whereby you soften metal is called:

(a) case hardening
(c) normalizing
(b) annealing
(d) tempering

18. The heat treatment process whereby you harden metal, such as the cutting edge of a chisel, is:

(a) case hardening
(c) normalizing
(b) annealing
(d) tempering

19. The hardness of steel is determined by the percentage of:

(a) zinc
(c) carbon
(b) nickel
(d) iron

20. The young man starting to work as a machinist is:

(a) a journeyman
(c) a technician
(b) a machinist
(d) an apprentice

21. Generally speaking, large drills are operated at:

(a) a high speed
(c) a low speed
(b) a medium speed
(d) any speed

22. The folded edge on a sheet metal box, thus eliminating a sharp edge, is called:

(a) a fold
(c) a bend
(b) a seam
(d) a hem

23. 90° bends on sheet metal are made on:

(a) a bar folder

(b) a slip roll

(c) a squaring shear

(d) a rotary machine

24. The most economical means to mass produce metal objects, such as an automobile hood, is:

(a) casting

(b) forging

(c) die stamping

(d) machining

25. Circles are best cut out of sheet metal with:

(a) tin snips

(b) squaring shear

(c) diagonals

(d) aviation snips

SAN LORENZO UNIFIED SCHOOL DISTRICT
Division of Secondary Instruction

JUNIOR HIGH SCHOOL INDUSTRIAL ARTS

TEST OF SUBJECT COMPREHENSION

POWER MECHANICS

Directions:

1. Fill in the requested information on your ANSWER SHEET.

2. Do not write in the question booklet.

3. Write only on the ANSWER SHEET.

4. Mark out the letter which makes the best answer to the statement.
   DO NOT circle the letter.

5. Look at the Sample Question X, below.

6. The correct answer is "C"; therefore, on your ANSWER SHEET for Sample X, "C" is marked out.

7. Do not open the test booklet until your instructor tells you to do so.

SAMPLE QUESTION X

Nails are driven with:

(a) a plane
(b) a screwdriver
(c) a hammer
(d) a saw

SAN LORENZO UNIFIED SCHOOL DISTRICT
Division of Secondary Instruction

POWER MECHANICS

1. The drill press employs the ________ to put pressure on the cutting edge of the drill bit as it is boring a hole.

   (a) lever principle
   (b) rotating principle
   (c) friction principle
   (d) twisting principle

2. Ropes and pulleys are a form of:

   (a) natural power
   (b) manual power
   (c) combustion power
   (d) pneumatic power

3. A ramp leading up a loading dock is a ______ type of power.

   (a) lever leverage
   (b) inclined plane
   (c) rolling friction
   (d) external combination

4. Friction is greatest when:

   (a) the load is stationary
   (b) the load is moving very fast
   (c) the load is moving very slowly
   (d) the load is raised

5. Manual power is the ability to do work through the use of:

   (a) air pressure
   (b) electricity
   (c) steam
   (d) lever and pulleys

6. The wind was used as a source of power before the:

   (a) feet
   (b) hammer
   (c) automobile
   (d) fire

7. The sun is a _______ source of power.

   (a) mechanical
   (b) thermodynamics
   (c) natural
   (d) hydroelectric

8. Steam power is a ________ process.

(a) internal combustion
(b) external combustion
(c) thermo-hydro
(d) hydromechanical

9. The wind as a source of power is used to change rotary motion to up and down motion in the:

(a) sailboat
(b) windmill
(c) glider
(d) helicopter

10. A water wheel uses ______ as a source of power.

(a) water pressure
(b) stored water
(c) potential water
(d) running water

11. All electrical power tools should be:

(a) 220 volt
(b) 110 volt
(c) grounded
(d) new

12. Gasoline as a fuel for power is very:

(a) explosive
(b) costly
(c) harmful
(d) corrosive

13. When cleaning, oiling, or adjusting any power machine, the:

(a) power is off
(b) machine is clear
(c) power is off and disconnected
(d) machine has stopped

14. Gasoline should be stored in:

(a) open containers
(b) vented containers
(c) closed metal containers
(d) closed glass containers

15. Turbine engines are dangerous because:

(a) they turn up high RPM's
(b) they use highly explosive fuel
(c) they are made of lighter metals
(d) they are not water cooled

16. A solar battery gets its energy from:

(a) a hydroelectric plant
(b) a thermodynamic plant
(c) the sun
(d) a nuclear plant

17. Steam power can be obtained from:

(a) nuclear power
(b) manual power
(c) wind power
(d) natural power

18. A diesel engine's power is obtained by:

(a) compressing air and fuel until it explodes
(b) compressing fuel and injecting air to explode
(c) compressing air and injecting fuel to explode
(d) compressing fuel until it explodes

19. A hydroelectric plant is:

(a) a generator driven by water
(b) a generator driven by atomic power
(c) a generator driven by steam power
(d) a generator driven by diesel power

20. Magnetism is a source of:

(a) mechanical power
(b) atomic power
(c) electrical power
(d) natural power

21. Hydraulic power is:

(a) doing work with fluid
(b) doing work
(c) doing work with fluid under different pressures
(d) doing work with fluid under pressure

22. Hydraulic motors are:

(a) easily adapted to do different jobs
(b) made to do all heavy and light jobs with same size motors
(c) only used as motors, not pumps
(d) inexpensive to purchase

23. In using pneumatic power, one has to be careful of:

(a) type of compressor

(b) amount of working space

(c) water condensation

(d) type of working space

24. For future transportation in the auto industry, which is the least likely to be promoted soon?

(a) electrical

(b) steam

(c) air power

(d) atomic

25. Why should you, as an individual, start to think and train for your future life's work?

(a) The longer you train, the better you will be.

(b) You can get a much broader view of your future work.

(c) You can find out early if you want to change.

(d) You can prepare yourself better for changes to come in industry.

SAN LORENZO UNIFIED SCHOOL DISTRICT
Division of Secondary Instruction

JUNIOR HIGH SCHOOL INDUSTRIAL ARTS

TEST OF SUBJECT COMPREHENSION

WOODWORKING

Directions:

1. Fill in the requested information on your ANSWER SHEET.
2. Do not write in the question booklet.
3. Write only on the ANSWER SHEET.
4. Mark out the letter which makes the best answer to the statement. DO NOT circle the letter.
5. Look at the Sample Question X, below.
6. The correct answer is "C"; therefore, on your ANSWER SHEET for Sample X, "C" is marked out.
7. Do not open the test booklet until your instructor tells you to do so.

SAMPLE QUESTION X

Nails are driven with:

(a) a plane
(b) a screwdriver
(c) a hammer
(d) a saw

SAN LORENZO UNIFIED SCHOOL DISTRICT
Division of Instruction

WOODWORKING

1. An example of hardwood is:

(a) Douglas fir
(b) white pine
(c) walnut
(d) alder

2. Ripsaw teeth are shaped like:

(a) chisels
(b) knives
(c) wedges
(d) shears

3. Nails driven at an angle:

(a) are easier to drive
(b) hold better
(c) do not bend easily
(d) have less tendency to split out

4. The nail best suited for cabinet work is:

(a) a common
(b) a box
(c) a finish
(d) an escutcheon

5. The nail best suited for framing a house is:

(a) a common
(b) a finish
(c) an escutcheon
(d) a brad

6. Hand planing is done:

(a) with the grain
(b) *against the grain*
(c) across the grain
(d) from the center in both directions

7. A beam formed by gluing pieces together is called:

(a) a multi-piece beam
(b) a laminated beam
(c) a built up beam
(d) an extruded beam

8. Dull chisels:

(a) are easier to control as they cut more slowly
(b) are hollow ground
(c) reflect light on the edge
(d) are open ended

9. When giving dimensions of lumber, ...

(a) width
(b) length
(c) number of pieces
(d) thickness

.....is given last.

10. Growth of a tree occurs in the:

(a) heartwood
(b) pith
(c) sapwood
(d) cambium layer

11. Bevels and chamfers are checked with a:

(a) try square
(b) framing square
(c) T-bevel
(d) foot rule

12. When correctly used, the marking gauge is used:

(a) with the head upright
(b) with the head tilted, pin trailing
(c) with pin extended $\frac{1}{4}$ inch
(d) with pin vertical

13. A 45° angle is associated with a:

(a) butt joint
(b) dado joint
(c) dovetail joint
(d) miter joint

14. Which of the following abrasives is the finest:

(a) $1\text{-}\frac{1}{2}$
(b) 1
(c) 4/0
(d) 6/0

15. As a rule, never sand:

(a) with the grain
(b) across the grain
(c) with a block
(d) with fine sand paper

16. The operation associated with a flathead screw is a:

(a) counterbore
(b) ream
(c) spotface
(d) countersink

17. Bench rules are divided into:

(a) $\frac{1}{16}$
(b) $\frac{1}{8}$
(c) $\frac{1}{4}$
(d) $\frac{1}{32}$

18. Staining of wood is done to:

(a) hide scratches
(b) hide blemishes
(c) enhance the beauty of the wood
(d) seal the wood

19. Which of the following is not a type of joint:

(a) butt
(b) auger
(c) dado
(d) rabbet

20. Which of the following is an open grain wood:

(a) pine
(b) maple
(c) birch
(d) ash

21. Which of the following is a closed grain wood:

(a) birch
(b) ash
(c) walnut
(d) mahogany

22. The tool used to lay out rafters is a:

(a) framing square
(b) try square
(c) T-bevel
(d) combination square

23. Glue is spread:

(a) thick on both surfaces
(b) evenly on one surface
(c) evenly on both surfaces
(d) thick on one surface

24. For a smooth finish, filler would be applied to the following wood:

(a) walnut
(b) cedar
(c) pine
(d) birch

25. Screws are driven with:

(a) a hammer
(b) a jack hammer
(c) an auger
(d) a screwdriver

APPENDIX "C"

EDUCATIONAL SPECIFICATIONS

TRANSPORTABLE DRAWINGS

ROTATIONAL CHART

EDUCATIONAL SPECIFICATIONS FOR THE HOUSING AND LAYOUT OF INDUSTRIAL ARTS SHOPS

Educational specifications, organized under eight phases of school shop planning, appear in this section. These phases are the shop building, flexibility and expansibility of shops, size and dimensions of shops, the open shop area—equipment and layout, auxiliary rooms and facilities, visual comfort and efficiency, ventilation and heating, and shop flooring. At the end of these educational specifications a list of steps that should be taken in planning new facilities for industrial arts is presented.

A. THE SHOP BUILDING	Transportables
1. School shops should be housed in one or more separate buildings or in wings of the school building that are designed for shop use.	Yes
2. Shop buildings or shop wings should be one-story structures.	Yes
3. Building units should be connected by covered walks where climatic conditions make it necessary.	No
4. The site area devoted to industrial arts shops should be large enough to provide for future expansion; it should be adjacent to or connected with the other areas used for educational purposes (not isolated); and it should be easily accessible by automobile and truck. An adequate parking area should be provided.	Yes
5. Shops in which noisy activities are conducted should be located so that the noise will not disturb other school activities. This does not mean isolation.	Yes
6. Shops should be located so that they are easily accessible for evening school use.	Yes
7. Auto shops and other shops that must be accessible to automobiles or trucks should have entrances and exits located on driveways.	Yes
8. School shops should not be located in basements.	Not Applicable
9. Shops should be acoustically treated with material that will permit repeated refinishing.	Yes
10. Shop ceiling height should be a minimum of 12 feet, preferably 14 feet. Additional height for vertical storage of materials should be provided when necessary.	No
11. School shop construction and installations should conform to the California State Department of Education and California Division of Industrial Safety regulations.	Yes
B. FLEXIBILITY AND EXPANSIBILITY OF SHOPS	
12. Nonbearing partitions may be used between shops to secure flexibility.	Not Applicable
13. The fenestration pattern should provide for windows along the entire wall rather than for windows grouped for each shop.	No
14. Facilities for power and other utilities should be based on a liberal rather than on a restricted estimate of future needs.	Yes
15. A standard type of cabinets, lockers, shelves, and work benches should be used in all shops.	Yes
16. Shelving in cabinets, lockers, and other shelf areas should be of the adjustable type except where safety requires rigid shelving.	Yes
17. The site area should be sufficiently large for future additions.	Yes

---

[1] California Industrial Arts Shop Planning Committee, A Guide For Planning and Equipping Industrial Arts Shops in California Schools (Sacramento, California: California State Department of Education, 1956) pp. 1-7.

C. SIZE AND DIMENSIONS OF SHOPS

18. The area for an industrial arts shop should be determined by analyzing the space requirements for each activity and for the equipment that will be used in the activities. The following space allotments are recommended as a guide in the establishment of space requirements for the *open shop area.* Space for auxiliary rooms should be added to allotments for open shop areas. The allotments for industrial arts shops are based on a class size of 24 students.

Space Allotments Recommended for Open Area in Industrial Arts Shops (24 Students)

Group I Shops

Auto Mechanics and Auto Essentials;[1] senior high school Electric-Radio; senior high school Graphic Arts; junior high school and senior high school General Metal, General Wood, and Comprehensive General.

Space	*Square Feet Per Student*	*Square Feet Total Open Shop Area*
Minimum	75	1800
Adequate	100	2400
Desirable	125	3000

Group II Shops

Drawing;[2] junior high school Electric, Graphic Arts and Drawing; Graphic Arts; and Handicraft.

Space	*Square Feet Per Student*	*Square Feet Total Open Shop Area*	
Minimum	50	1200	
Adequate	75	1800	- - - - Yes
Desirable	100	2400	

19. The open shop area should be rectangular in shape. Yes
20. The width-to-length ratio of the open shop area should be approximately 2:3. Yes

D. THE OPEN SHOP AREA—EQUIPMENT AND LAYOUT

21. The entire shop area should be visible from any point. Yes
22. Arrangement of equipment, machines, and work stations should be determined by considerations of safety, work procedures, flow of materials, and instructional efficiency. Yes
23. Aisles of travel should be provided for free flow of traffic between all areas and points of common use such as auxiliary rooms, tool panels, and common machine areas. Such aisles should be at least 4 feet in width. Yes
24. Spacing between benches, machinery, and other equipment should be sufficient for students' safety and for free passage. The amount of such space between benches, machinery, and equipment is determined by the nature of the shop work and the equipment, but in all instances should be at least 3 feet. Yes
25. Operators' safety zones at machines should be designated on the floor by painted lines or in some other way. Yes

---

[1] In auto mechanics and auto essentials shops, due to the space required for automobiles that are being worked on, the open shop areas exceed 2400 square feet.

[2] Industrial drawing or drafting room based on a class size of 30 students because of the nature of the activity.

26. All shops should have at least two exit doors. One door should be large enough to accommodate the largest piece of equipment or instructional project to be moved in or out of the shop.	Yes
27. Open floor spaces should be provided near entrances and exits to eliminate congestion.	Yes
28. A clear floor space should be provided in front of tool panels.	Yes
29. An adequate area should be allocated in each comprehensive general shop, wood shop, and other shops requiring space for project assembly.	Yes
30. The auto shop should have an off-the-street area outside the shop, surfaced and fenced, a portion of which should be covered by a cantilever roof.	Not Applicable
31. If lumber, bar steel, and other materials are to be stored in the open shop area, special racks and shelving should be provided.	Yes
32. Equipment, except that of the portable type, should be fastened securely to the floor, a heavy bench, or other stable foundation.	Yes
33. Machines that create a vibration problem should be cushioned with rubber mountings or other shock-absorbing material.	Yes
34. Bases for cabinets, benches, and machines should provide toe space for the comfort of the student worker.	Yes
35. Equipment should be placed to allow for ease of cleaning around the base.	Yes
36. The operating level of equipment should be a comfortable working height for the students.	Yes
37. The start-stop switch on a machine should be located within easy reach of the operator.	Yes
38. Work benches with lockers below should be provided along outer walls where needed.	No
39. Machines that are used for roughing out stock should be placed near the storage areas.	Yes
40. Storage should be provided for students' personal belongings and partially completed small projects.	Yes
41. Lockers should be located in an area where they can be readily supervised by the instructor.	Yes
42. Illuminated display cases should be provided both in the shop and in central locations in the school plant.	Yes
43. Power controls should be centralized on a master control panel that can be locked, has a pilot light, and is located near the instructor's desk or office. Remote safety relay cutout switches controlling the main power supply may also be provided.	Yes
44. Shops using portable power tools should be provided with one double electric wall outlet for every 10 feet of wall space, with provision for grounding cord.	Yes
45. Adequate washing facilities should be provided in each shop.	Yes
46. Hot water should be available in each shop.	Yes
47. Each shop should have a drinking fountain located where it will not cause congestion and, for purposes of supervision, can be seen from any point in the shop.	Yes
48. Tack boards and chalkboards should be placed at strategic locations in each shop.	Yes
49. Fire extinguishers are required shop service equipment and must be located conveniently and marked or labeled conspicuously.	Yes
50. Provision should be made for the location of a first-aid kit.	Yes
51. Adequate systems should be provided for the collection and disposal of dust and shavings.	Yes
52. Space should be set aside in each shop for the waste and refuse container.	Yes

E. AUXILIARY ROOMS AND FACILITIES

53. All shop auxiliary rooms and areas should be planned along with the rest of the shop. Among these are the supply and special tools room; project storage room or area; shop classroom or instructional area; planning, library, and office room; finishing room; and material storage room.	Not Applicable
54. Each shop should have a supply and special tools room. The size is determined by the nature of the shop work, the number of students enrolled, and the type and quantity of supplies and tools stored.	Not Applicable
55. The material storage room or area should be located conveniently for the unloading of delivery trucks and for issuing materials to the students.	Not Applicable
56. Rooms for the storage of the supplies and special tools used in evening classes and the storage of projects made should be provided in shops that are to be used extensively by evening classes.	Not Applicable
57. Both the supply room and the tool panel should be so located that students, in reaching them and returning to their work stations, pass as few work stations as possible.	Not Applicable
58. Racks, shelving, drawers, and closed cabinets designed for items to be stored should be provided in the supplies and special tools room.	Not Applicable
59. A small shop classroom is a highly desirable adjunct to most shops for planning, drafting, and related studies. A specially equipped space in the open shop area or a nearby standard classroom may be used for this purpose.	Not Applicable
60. A shop classroom of 480 square feet (20 by 24 feet) is large enough for most shops. For an instructional space in the open shop area, 12 by 18 feet should suffice.	Yes
61. The shop classroom should be equipped with a teacher's desk, necessary chairs and tables, adequate chalkboard and tack board, shelving for books, and cabinets for storage of instructional material. The room should be acoustically treated.	Yes
62. Shop classrooms and regular classrooms used for instructional purposes should be equipped for the use of visual aids.	Yes
63. Electrical outlets and controls in shop classrooms should be located where they may be used with a minimum of teacher movement. The controls for room lights and the projector outlet should be at the same point.	Yes
64. If instructional space in the open shop area is used instead of a classroom, it should be provided with a teacher's desk, chalkboard, necessary seating, and cabinets for storage of instructional materials.	Yes
65. Toilet facilities for all shops should be located at a central point in the shop building.	Yes
66. An air compressor unit should be located where all shops requiring compressed air may use it.	Not Applicable
67. The air compressor unit should be located so that it can be conveniently serviced, and noise from its operation will not disturb classes.	Yes
68. A separate dustproof finishing room equipped with a commercial type spray booth is necessary for shops in which finishing is done.	Not Applicable

F. VISUAL COMFORT AND EFFICIENCY

69. Full advantage should be taken of all possibilities for natural lighting. North light should be provided whenever possible.	No
70. When daylight is inadequate, it must be supplemented by sufficient electric light to provide illumination that meets adopted standards.	Yes

71. Artificial lighting systems should produce a uniform distribution of shadow-free light, and equipment and walls should be glare free. Yes
72. Artificial lighting should be secured by the use of fixtures that produce indirect or semi-indirect light. Yes
73. Artificial lighting for shops in general should yield a minimum of 50 foot candles on the work. Lighting for tasks that are difficult to see should provide as much as 100 foot candles or more. Yes
74. General lighting should be supplemented by special lighting for each machine and for areas where precision work is done. Yes
75. Ceilings should be painted an off-white. Walls, trim, and built-in equipment should be a light color. Yes
76. Furniture and other shop equipment should be finished in light colors. Yes
77. Machinery and equipment should be painted in colors that are conducive to eye comfort and safety. Yes
78. The machine body should be finished in a color that will create a visual working area that minimizes eye fatigue and strain. Yes
79. Certain operating parts should be finished in colors that are in strong contrast to the machine body. Yes
80. High visibility colors should be used on control levers and switch boxes, with black for starting button and red for stop button. Yes

G. VENTILATION AND HEATING

81. The heating and ventilating system should be adequate to maintain comfortable and healthful conditions at all times. Yes
82. Dust, smoke, odors, fumes, vapors, and gases should be exhausted by mechanical means. Yes
83. Provision should be made for all engines operated in the shops to be muffled and connected to exhaust pipes that discharge outside the building. Yes
84. The heating system should maintain automatically for shops a temperature of 68° F. measured 60 inches above the floor, and for classrooms a temperature of 70° F. measured 30 inches above the floor. Yes
85. The temperature variation from floor to 60 inches above the floor should not exceed 5°. Yes

H. SHOP FLOORING

86. The floors should have a pleasing appearance, be easy to clean, be of a material that will require a minimum of repairs, and be finished to reduce the danger of slipping. Yes
87. The flooring materials will differ from shop to shop according to the activities conducted in each shop. Yes

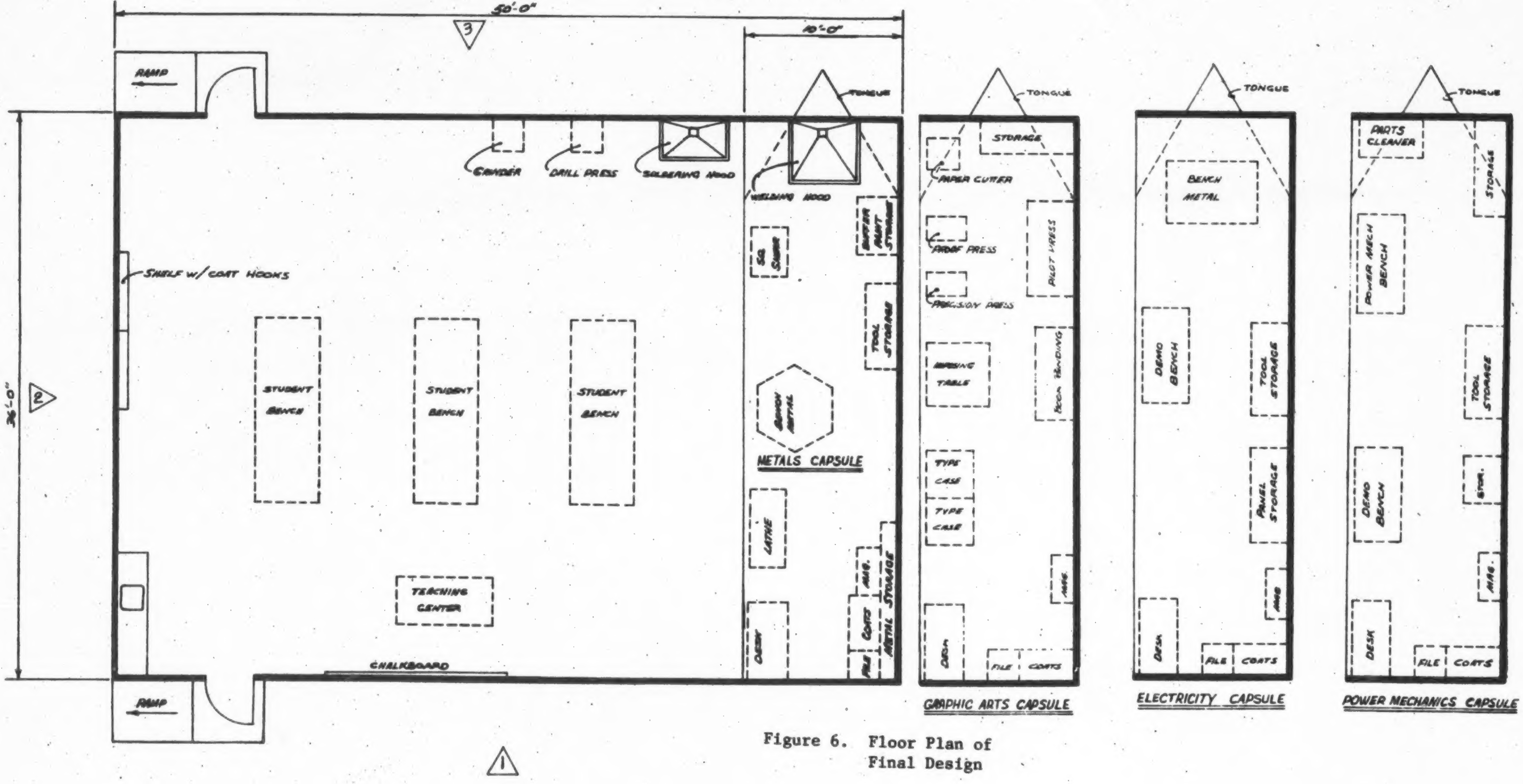

50'-0"
3
10'-0"
36'-0"
2
1
RAMP
RAMP
TONGUE
TONGUE
TONGUE
TONGUE
GRINDER
DRILL PRESS
SOLDERING HOOD
WELDING HOOD
SHELF w/ COAT HOOKS
STUDENT BENCH
STUDENT BENCH
STUDENT BENCH
TEACHING CENTER
CHALKBOARD
SQ. SHEAR
BUFFER PAINT STORAGE
TOOL STORAGE
BENCH METAL
METALS CAPSULE
LATHE
DESK
MAG.
COATS
FILE
METAL STORAGE
STORAGE
PAPER CUTTER
PROOF PRESS
PRECISION PRESS
PILOT PRESS
IMPOSING TABLE
BOOK BINDING
TYPE CASE
TYPE CASE
MAG.
DESK
FILE
COATS
GRAPHIC ARTS CAPSULE
BENCH METAL
DEMO BENCH
TOOL STORAGE
PANEL STORAGE
MAG
DESK
FILE
COATS
ELECTRICITY CAPSULE
PARTS CLEANER
STORAGE
POWER MECH BENCH
TOOL STORAGE
DEMO BENCH
STOR.
MAG.
DESK
FILE
COATS
POWER MECHANICS CAPSULE

Figure 6. Floor Plan of Final Design

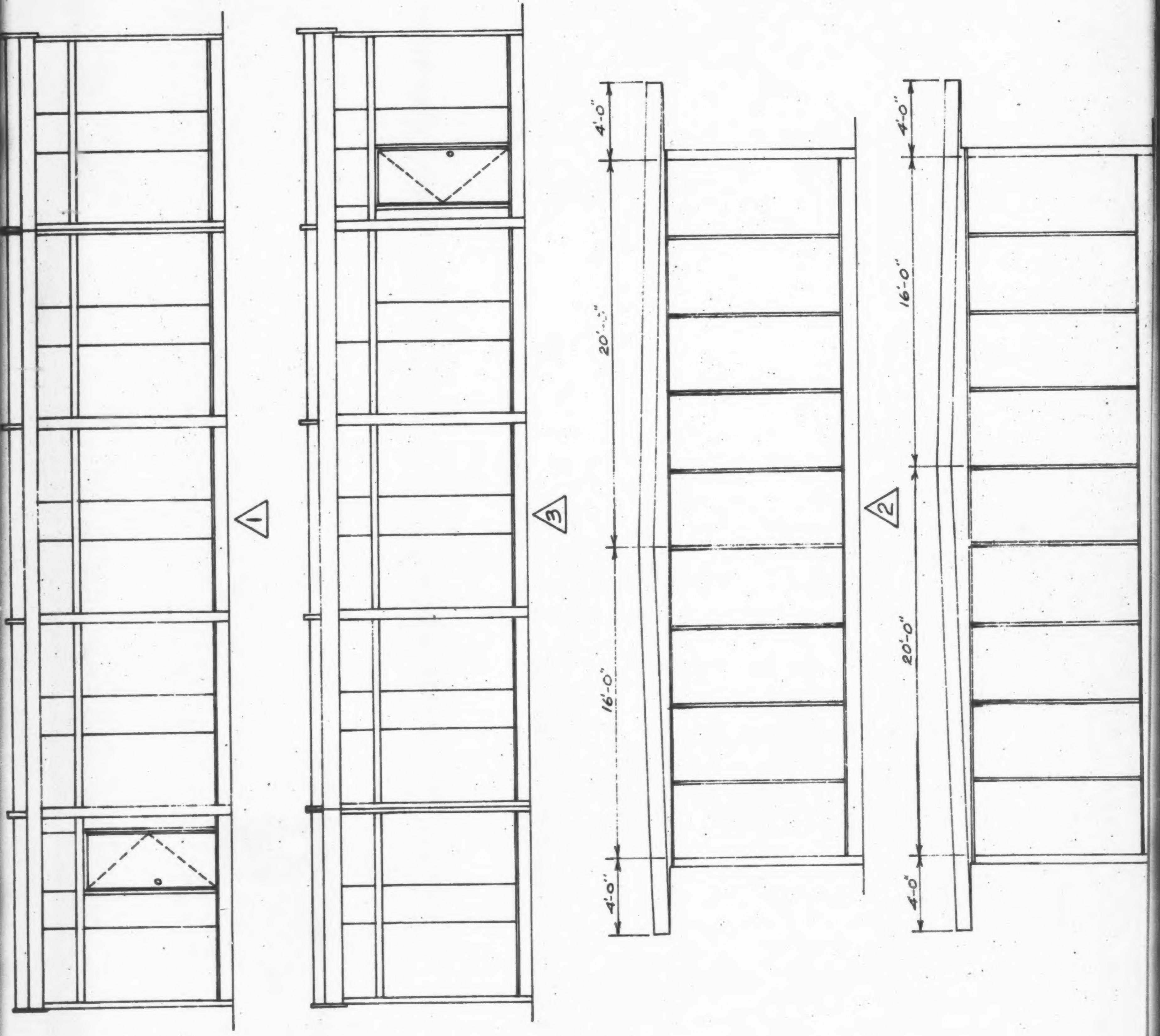

1
3
4'-0"
20'-0"
16'-0"
4'-0"
2
4'-0"
16'-0"
20'-0"
4'-0"

Figure 7
Elevations of Final Design

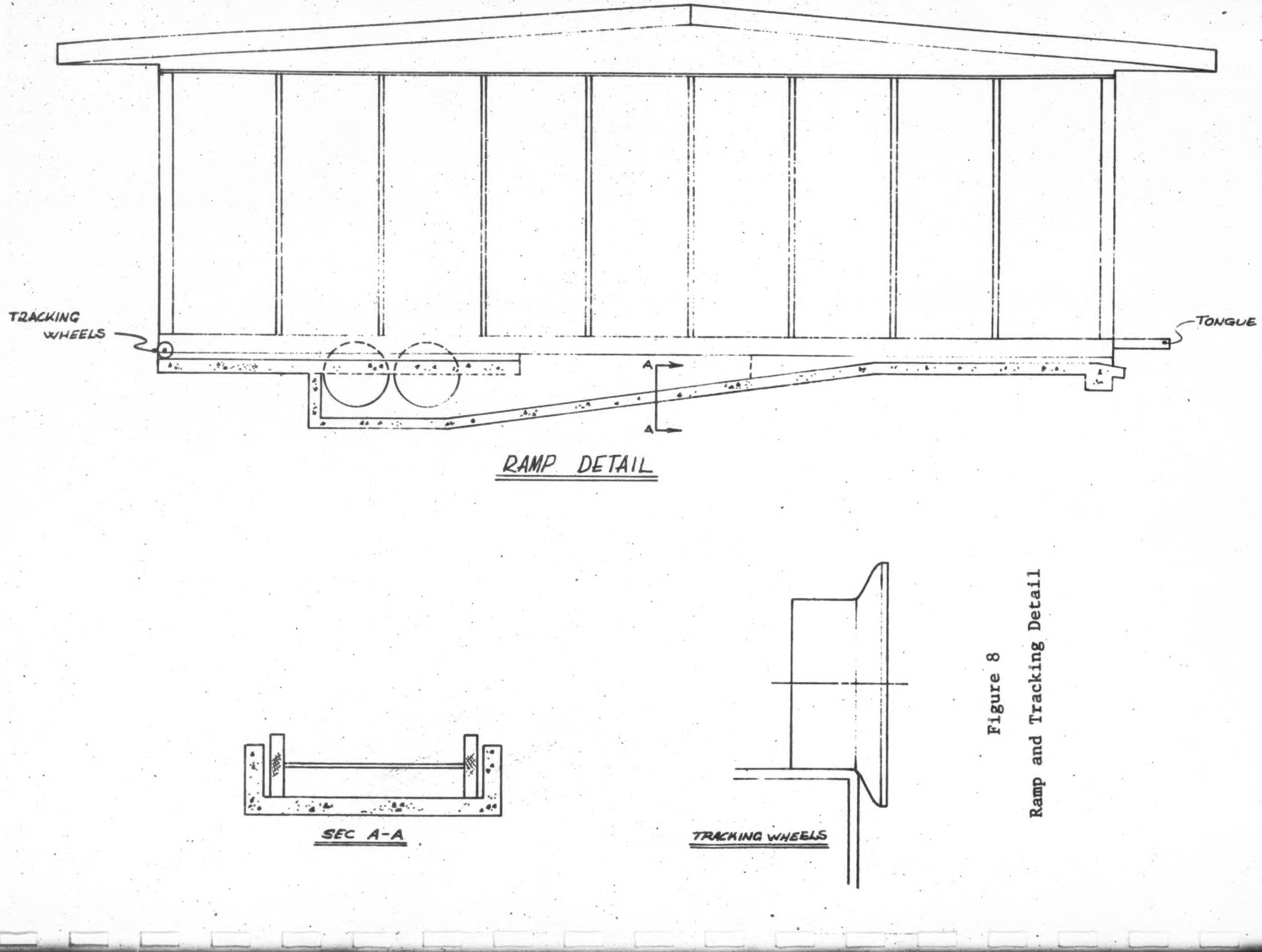
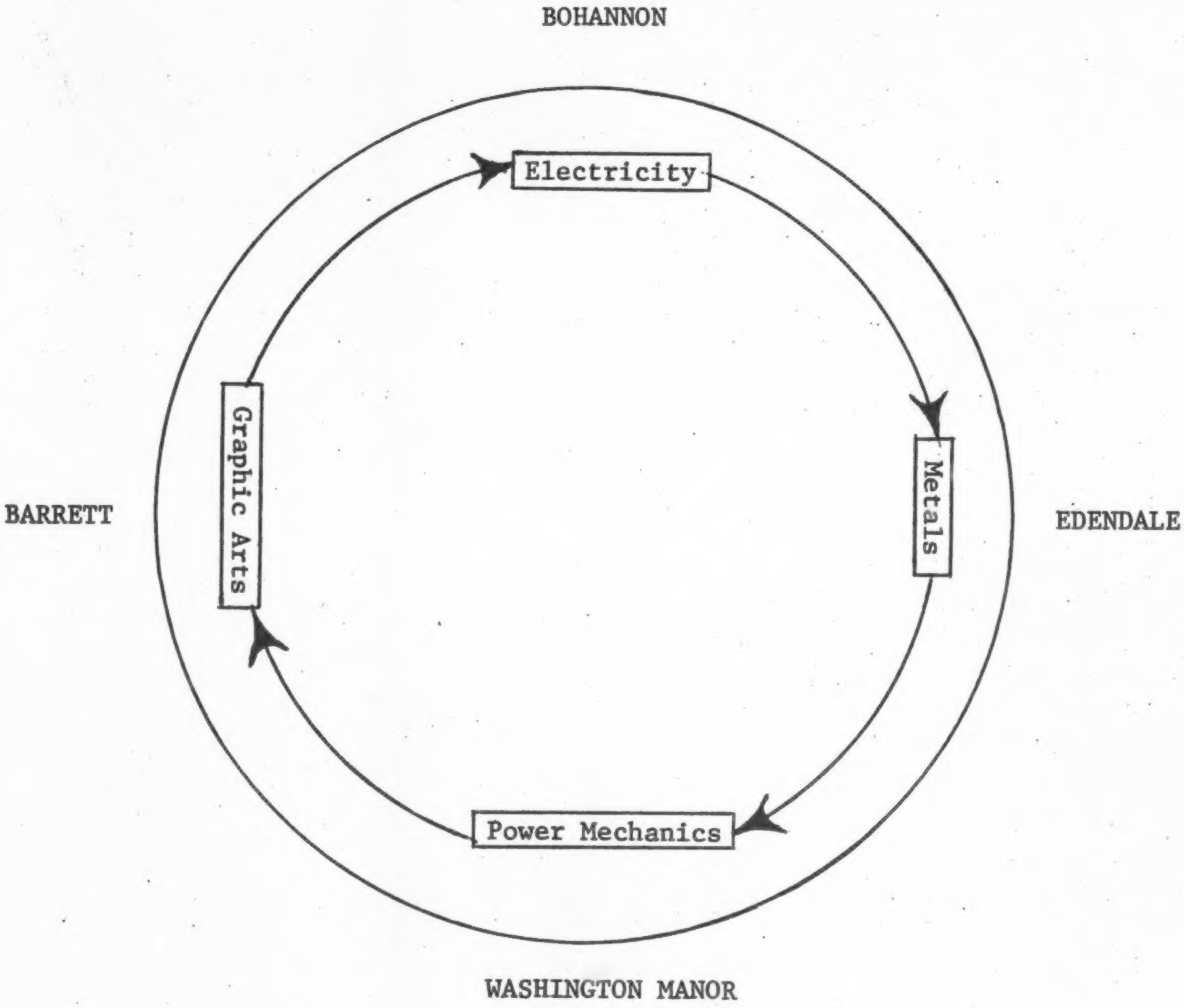

TRACKING WHEELS
TONGUE
A
A
RAMP DETAIL
SEC A-A
TRACKING WHEELS

Figure 8

Ramp and Tracking Detail

TRAILER ROTATION SCHEDULE


BOHANNON
Electricity
Metals
EDENDALE
Power Mechanics
WASHINGTON MANOR
Graphic Arts
BARRETT

First move:	November 15 - Saturday
Second move:	January 30 - Friday
Third move:	April 11 - Saturday

1969-70

APPENDIX "D"

COURSE OUTLINES

- DRAFTING
- ELECTRONICS
- GRAPHIC ARTS
- METALS
- POWER MECHANICS
- WOODWORKING

DRAFTING

COURSE

OF

STUDY

DRAFTING

Unit I

I. TITLE: Idea Visualization

II. PURPOSE:

A. To explore the role of graphic representation and its historic beginnings.

B. To discover the relationship of symbols to describe objects.

C. To experience the translation of ideas and shapes into graphic representations.

III. BEHAVIORAL OBJECTIVES:

A. Students will be able to cite three examples of the role of graphic communications in recording history.

B. Given an oral description, students will be able to express their interpretation graphically.

IV. TIME: 1 Week

V. LESSON CONTENT:

A. Historical Beginnings

1. Cavemen
2. Egyptians
3. Romans
4. Indians

B. Graphic Interpretation

1. Geometric shapes
2. Lines
3. Symbols

C. Freehand sketching

1. Materials
2. Techniques
3. Aids
4. Proportions

DRAFTING

Unit II

I. TITLE: Equipment Procedure

II. PURPOSE:

A. To acquaint students with the various types of tools used in the drafting field.

B. To experience the proper use and care of the drafting tools used in producing sketches and drawings.

C. To explore the equipment used in industry in the production and reproduction of drawings.

III. BEHAVIORAL OBJECTIVES:

A. Students will be able to use drafting equipment properly and with accuracy.

B. Students will recall the proper uses and care of the tools of drafting.

IV. TIME: 1 week

V. LESSON CONTENT:

A. Drafting Boards

1. Various types and sizes
2. Keeping surface and edge true.
3. Care of surface

B. Pencils:

1. Discuss the differences of degrees
2. Selecting the proper grade
3. Sharpening to proper point

C. Drafting Paper

1. Sizes and weights and colors compared
2. Using erasing shields and erasers on paper
3. Use of T-Square on lining up paper on board

D. Triangles

1. Care and use of the two triangles
2. Using in drawing lines of different angles as well as vertical

E. Scales

1. Full
2. Half

DRAFTING

Unit III

I. TITLE: Shape Description

II. PURPOSE:

- A. To describe object using the graphic language.
- B. To explore the various ways of interpreting an object.

III. BEHAVIORAL OBJECTIVES:

- A. Students will be able to describe simple objects graphically.
- B. Students will be able to explain the procedures for developing the drawing.

IV. TIME: 4 weeks

V. LESSON CONTENT:

- A. Alphabet of Lines
    1. Hidden lines
    2. Border lines
    3. Construction lines
    4. Center lines
    5. Object lines
    6. Cutting plane lines
- B. Orthographic Projection
    1. One-View Drawings
        - a. Sheet metal development
        - b. Gaskets
        - c. Notes to indicate thickness
    2. Two-View Drawings
        - a. Cylindrical objects
        - b. Duplication of views avoided
        - c. Centering of views
    3. Three-View Drawings
        - a. Rectangular solids
        - b. Woodworking projects
        - c. Shop drawings
        - d. Relationships between all three views
            - (1) Front, top, right side or end
            - (2) Spacing between views
            - (3) Centering of the views

DRAFTING

Unit III (Cont.)

C. Pictorial Drawings

1. Oblique Drawings

    a. Cavalier drawings

        (1) Depth dimension full size
        (2) Front view is true shape
        (3) Distortion of depth
        (4) Depth axis either 30 or 45 degrees

    b. Cabinet drawings

        (1) Depth dimension half-size
        (2) Front view is true shape
        (3) Distortion of depth minimized
        (4) Depth axis either 30 or 45 degrees

2. Isometric Drawings

    a. 30 degree axis (left and right)
    b. Depth, width, height dimensions are true or full size
    c. Identification of isometric and non-isometric lines
    d. Discover the parallel line measures
    e. Centering the isometric drawing
    f. Use of construction lines

DRAFTING

Unit IV

I. TITLE: Size Description

II. PURPOSE:

A. To experience the process of indicating the size or relationships of an object or a product.

B. Use of the different symbols for showing size and shape.

C. To explain the mechanics of dimensioning by use of simple drawings.

D. To become aware of the need for using dimensioning in graphic representations.

III. BEHAVIORAL OBJECTIVES:

A. Given a simple drawing, students will be able to dimension using the conventional method.

B. Students will understand placement of dimension and will be able to avoid over-dimensioning.

C. Students will be able to distinguish between location and size dimensioning.

IV. TIME: 1 Week

V. LESSON CONTENT:

A. Extension Lines

1. About 1/16-inch from view
2. Dark and thin
3. Does not cross dimension lines
4. Avoid using on hidden line views
5. Ends about 1/8-inch after last arrowhead

B. Dimension Lines

1. About 1/4-inch from views
2. Space for numerals
3. Thin and light
4. Must touch extension lines
5. If more than one line, same spacing needed for next line
6. Avoid crossing one another

C. Arrowheads

1. Must touch extension or center line when indicating location dimension
2. When used for size dimension must tough inner or outer part of circle or arc.

3. Should be 1/3 as wide as long
4. Not "V" shaped
5. Dark and thin

D. Numbers (Whole) and Franctions

1. Fraction line should line up with the dimension line
2. Whole numbers are about 1/8" tall
3. Fractions about 1/4" tall
4. Avoid placing numbers directly under or above each other
5. Must be made either slanting to the left or vertical

E. Notes

1. A leader should be used when indicating a size of a circle
2. Notes are placed outside of the view
3. The leader should have an arrowhead on the end where it indicates the size.
4. Guide lines needed for notes

F. Placement

DRAFTING

Unit V

I. TITLE: SELECTION OF DRAWINGS

II. PURPOSE

A. To experience the best way to represent an object or project.

B. To discover the advantages of one representation over another.

III. BEHAVIORAL OBJECTIVES:

A. Given a choice, students will be able to select the best graphic representation of an object or product.

B. Students will be able to represent an object in more than one method using the graphic language.

IV. TIME: 2 Weeks

V. LESSON CONTENT:

A. Student will be given a series of objects which may be drawn:

1. As an isometric drawing
2. As a three-view drawing
3. As a one or two view drawing (depending on the object)
4. As a sheet metal development
5. As either cabinet or cavalier oblique

B. Drawing of woodworking or metalworking projects

1. A working or another type may be employed to graphically represent a given project
2. A dimensioned working drawing of a shop project to be later used in that area
3. An isometric drawing along with the working drawing of an article to be made

C. Students may choose the media for representing a given product.

D. Same problem drawn in various methods employed.

ELECTRICITY-ELECTRONICS

COURSE
OF
STUDY

ELECTRICITY-ELECTRONICS

Unit I

I. TITLE: Use of Meters, VTVM and VOM

II. PURPOSE:

- A. To become familiar with meters and their use.
- B. To explore the versatility of the VTVM.
- C. To experience measuring techniques.

III. BEHAVIORAL OBJECTIVES:

- A. Students will be able to operate the VTVM and VOM correctly in making full use of scales.
- B. Students will be able to prepare the meters correctly for storage.
- C. Students will be able to identify types of meters.

IV. TIME: 3 Days

V. LESSON CONTENT:

- A. Introduction to meters.
    1. Functions
    2. Ranges
    3. Adjustment dials
- B. Measuring direct current voltage
    1. Probe on DC
    2. Adjust needle to zero
    3. Scale reading
- C. Measuring alternating current voltage
    1. Probe on AC
    2. Adjust needle to zero
    3. Scale reading
- D. Measuring resistance
    1. Probe on AC
    2. Adjust for infinity
    3. Adjust for zero
    4. Scale reading
- E. Preparation for storage
- F. Comparison of meters and their function

ELECTRICITY-ELECTRONICS

Unit II

I. TITLE: Sources of Electricity

II. PURPOSE:

- A. To explore the sources of electricity.
- B. To familiarize students with two types of current.

III. BEHAVIORAL OBJECTIVES:

- A. Students will be able to identify crystals, generators, photocell, and thermocouple as sources of electricity.
- B. Students will be able to explain the basic theory of the dry cell battery.

IV. TIME: 4 Days

V. LESSON CONTENT:

- A. Battery
  - 1. Primary cell
    - a. Parts of the battery
    - b. Simplified chemical reaction
    - c. No load condition
    - d. Battery under load
    - e. Batteries not rechargeable (reasons)
    - f. Schematic symbols
  - 2. Storage battery
    - a. Parts of the battery (briefly)
    - b. Simplified chemical reaction
    - c. Schematic symbol
- B. Photoelectric effect
- C. Thermocouple effect
- D. Crystal effect

ELECTRICITY-ELECTRONICS

Unit III

I. TITLE: Conductors and Insulators

II. PURPOSE:

A. To discover the difference between conductors and insulators.

B. To compare conductivity of various materials.

C. To explore the principle of electron movement in a conductor.

III. BEHAVIORAL OBJECTIVES:

A. Students will be able to differentiate between conductors and insulators by simple circuit test (open circuit test).

B. Students will be able to explain how electrons move in a conductor.

C. Students will be able to explain the effect of length and diameter on the resistance of a wire.

IV. TIME: 5 Days

V. LESSON CONTENT:

A. Atomic Structure

1. The atom
2. Outer shell electrons
3. Characteristics determined by outer shell

B. Simple circuit test (lab. experiment).

1. Circuit construction from schematic
2. Experimentation with many materials

C. Measuring materials to determine amount of conductivity (use of Ohmmeter).

D. Importance of conductors and their use.

E. Importance of insulators and their use.

F. Electron movement

1. Speed per second
2. Demonstrate by use of marble slide (electron movement)
3. Illustrate electron movement

ELECTRICITY-ELECTRONICS

Unit IV

I. TITLE: Alternating Current and Direct Current

II. PURPOSE:

A. To explore differences between alternating current and direct current.

B. To discover why alternating current is usually used in power transmission.

C. To familiarize students with alternating current gounding system.

III. BEHAVIORAL OBJECTIVES:

A. Students will be able to differentiate between AC and DC.

B. Students will be able to identify which side of the AC line is common.

C. Students will be able to illustrate the 60 hertz sine wave.

IV. TIME: 6 Days

V. LESSON CONTENT:

A. Direct Current

1. Flows always in one direction (polarity)
2. Sources of direct current
3. Transmission of direct current
4. Uses of direct current

B. Alternating Current

1. Flows in both directions
2. Develop sine wave by experiment
3. Sources of alternating current
4. Transmission of alternating current
5. Testing for grounded side of alternating current line
    a. AC voltmeter
    b. Test lamp
6. Uses of alternating current

C. Required safety precautions.

1. Make no AC measurement unless supervised.
2. House circuits should not be worked with until you have more knowledge and broader experience.

ELECTRICITY-ELECTRONICS

Unit V

I. TITLE: Transformer Theory and Practice

II. PURPOSE:

A. To discover the magnet effect produced by current through a coil of wire.

B. To explore the relationship of a moving magnet and a coil of wire.

C. To discover the principle of mutual inductance.

III. BEHAVIORAL OBJECTIVES:

A. Students will be able to explain basically how current is produced in a coil of wire by a moving magnet.

B. Students will be able to demonstrate the principle of mutual conductance.

C. Students will be able to apply transformer theory to classroom projects.

IV. TIME: 6 Days

V. LESSON CONTENT:

A. Coil, Ammeter, and Magnet

1. Magnet on plastic with metal filings
2. Coil with moving magnet

    a. Develop alternating current
    b. Show magnetic field change in AC demonstration

3. Current through coil develops magnetic field

    a. Develop alternating current
    b. Show magnetic field in AC demonstration

B. Basic Transformers

1. Three parts, primary, secondary, iron core
2. Cut away, pass around laminated core
3. Talk about changing field affecting secondary
4. Step-up and step-down transformer, differences
5. Auto transformer

ELECTRICITY-ELECTRONICS

Unit VI

I. TITLE: Parallel & Series Circuit

II. PURPOSE:

- A. To compare series and parallel circuits.
- B. To explore the effects of power sources in parallel and series.
- C. To discover advantages of both series and parallel circuits.

III. BEHAVIORAL OBJECTIVES

- A. Students will be able to differentiate between series and parallel.
- B. Students will be able to select the parallel battery circuit for maximum current.
- C. Students will be able to select the series battery circuit for maximum voltage.
- D. Students will be able to apply series and parallel circuits to practical situations.

IV. TIME: 5 Days

V. LESSON CONTENT:

- A. Drawing a parallel and series circuit.
- B. Water analogy.
    - 1. River forks joining
    - 2. Ocean waves
- C. Demonstrate parallel and series battery circuits.
    - 1. Parallel battery circuit
        - a. Voltage nearly same as one cell
        - b. Current capacity increases
    - 2. Series battery circuit
        - a. Voltage adds by cell
        - b. Current nearly the same as one cell
- D. Student experiment with parallel and series batteries.

E. Demonstrate parallel and series load configurations.

1. Parallel load
    a. Voltage same as applied
    b. Current divides

2. Series load
    a. Voltage drop across each load
    b. Current the same throughout circuit

F. Student experiment with parallel load.

G. Student experiment with series load.

H. Total review of parallel and series circuits.

E. Demonstrate parallel and series load configurations.

1. Parallel load

   a. Voltage same as applied
   b. Current divides

2. Series load

   a. Voltage drop across each load
   b. Current the same throughout circuit

F. Student experiment with parallel load.

G. Student experiment with series load.

H. Total review of parallel and series circuits.

ELECTRICITY-ELECTRONICS

Unit VII

I. TITLE: Solid State Diode

II. PURPOSE:

- A. To explore the basics of solid state theory.
- B. To acquaint student with diode operational principles.
- C. To experience the results of forward and reverse biasing.

III. BEHAVIORAL OBJECTIVES:

- A. Students will be able to explain basic diode theory.
- B. Students will be able to apply diode operation principles to classroom projects.

IV. TIME: 3 Days

V. LESSON CONTENT:

- A. Types of Diodes
- B. Input and output wave forms
  - 1. Illustration
  - 2. Oscilloscope demonstration
- C. Diode Theory
  - 1. Materials
  - 2. Impurities
    - a. "N" type
    - b. "P" type
  - 3. Junction
    - a. Hole and electron movement
    - b. Barrier
  - 4. Forward bias
  - 5. Reverse bias
  - 6. Peak inverse voltage
- D. Comparison of solid state diode to vacuum tube diode.

ELECTRICITY-ELECTRONICS

Unit VIII

I. TITLE: Crystal Radio

II. PURPOSE:

A. To explore the crystal tuner operation.

B. To demonstrate how the radio wave is changed moving through the crystal tuner.

C. To apply theoretical material learned from first of course to final project.

III. BEHAVIORAL OBJECTIVES:

A. Students will be able to explain how the crystal tuner operates.

B. Students will be able to define basic detection.

C. Students will be able to apply basic theory from beginning of course through all phases of project.

IV. TIME: 5 Days

V. LESSON CONTENT:

A. Schematic Diagram.

1. Explain each part (review)
2. Discuss capacitor action
3. Discuss ear phone action

B. Trace wave form from antenna to ear phones - review each component function.

1. Step up transformer
2. Tuned circuit
3. Diode
4. Ear phone

C. Relate to superheterodyne radio.

ELECTRICITY-ELECTRONICS

Unit IX

I. TITLE: Power Supply

II. PURPOSE:

A. To explore voltage rectification.

B. To explore filtering principles.

C. To apply theory from entire course to project.

III. BEHAVIORAL OBJECTIVES:

A. The students will be able to define rectification.

B. The students will be able to illustrate the basic principles of filtering network.

C. The students will be able to apply course theory to project.

IV. TIME: 5 Days

V. LESSON CONTENT:

A. Schematic Diagram

1. Explain each part (review)

a. Transformer
b. Single diode - show output
c. Develop bridge on breadboard (show full wave rectification)
d. Filtering circuit

(1) First capacitor
(2) Final results

B. Trace wave form from front to back.

1. Step down transformer
2. Rectifier
3. Filtering
4. Explain two ranges

GRAPHIC ARTS

COURSE
OF
STUDY

GRAPHIC ARTS

Unit I

I. TITLE: Printing Processes Letterpress

II. PURPOSE:

- A. Explore the individual processes involved in printing.
- B. Discover the relationship of various printing procedures with other graphic arts media.

III. BEHAVIORAL OBJECTIVES:

- A. To know and practice safety in the print shop.
- B. Students will know the opportunities available to them in the printing area and the localities where employment is available.
- C. Students may perform efficiently and with appreciation the completion of graphic arts processes.
- D. To measure the achievement and comprehension of the processes presented.

IV. TIME: 3 Weeks

V. LESSON CONTENT:

- A. Letterpress printing
  1. Historical beginnings
  2. Advantages and disadvantages
  3. Types of work done
- B. Lithography
  1. Advantages
  2. Design and layout performance
- C. Intaglio Printing
  1. Discover characteristics and design
  2. Use of intaglio printing in the field of graphics
- D. Silk screen
  1. Design and composition
  2. Combining of art and printing to form many attractive products

GRAPHIC ARTS

Unit II

I. TITLE: Typesetting Fundamentals

II. PURPOSE:

A. Introduce students to various types of tools used in printing.

B. Awareness of proper use and care of equipment of printing media.

III. BEHAVORIAL OBJECTIVES:

A. Students will know and identify parts, sizes and kinds of type.

B. Knowledge of printing terms and measurements.

C. Care and storage of type.

IV. TIME: 2 Weeks

V. LESSON CONTENT:

A. Hand composition

1. Basic type styles
2. Selection of type
3. Printing layouts
4. Making rough sketches
5. Finished layouts
6. Storage of type
7. Proof reading
8. Making corrections
9. Distribution of type

B. Operation of Job Press

1. Lock up of type forms
2. Introduce platen press
3. Press make-ready
4. Operation of platen press

GRAPHIC ARTS

Unit III

I. TITLE: Rubber Stamp Making

II. PURPOSE:

- A. Explore graphic arts area of rubber stamp making.
- B. To explore uses of rubber stamp making in graphic arts.

III. BEHAVIORAL OBJECTIVES:

- A. Students will be able to understand rubber stamp making.
- B. Students will be able to complete process of above media.
- C. Knowledge can become a profitable hobby.

IV. TIME: 1 Week

V. LESSON CONTENT:

- A. Equipment used
  1. Care and use
  2. Materials
  3. Safety
- B. Making of rubber stamp
  1. Procedure
     - a. Making of matrix
     - b. Time needed for vulcanization process
     - c. Mounting of rubber stamp

GRAPHIC ARTS

Unit IV

I. TITLE: Block Printing

II. PURPOSE:

- A. Furthering exploration of graphic arts media.
- B. Explore use of block printing in graphic arts.

III. BEHAVIORAL OBJECTIVES:

- A. Students will be able to visualize and select personal area of interest to design.
- B. Knowledge of block-cutting tools.
- C. Proper method of transfering design to linoleum blocks.

IV. TIME: 1 Week

V. LESSON CONTENT:

- A. Equipment used
  1. Care of use of carving tools
  2. Select proper type of linoleum
- B. Utilization of equipment
  1. Design
  2. Transfer
  3. Methods of carving
  4. Methods of printing

GRAPHIC ARTS

Unit V

I. TITLE: Book Binding

II. PURPOSE:

A. Exploring end product of graphic arts.

B. Make students aware of uses of book binding.

III. BEHAVORIAL OBJECTIVES:

A. Students will be able to cut paper using hand-operated lever cutter.

B. Knowledge of folding paper for books and other types of hand-out printed materials.

C. Be able to utilize various methods of basic types of book binding.

IV. TIME: 1 Week

V. LESSON CONTENT:

A. Make roughs and layouts for printing a suitable job for padding.

B. Set type and cut paper.

C. Perforating and stitching.

D. Casebound covers for books.

E. Gluing

F. Project selection and completion

GRAPHIC ARTS

Unit VI

I. TITLE: Occupational Opportunities

II. PURPOSE:

A. Explore various opportunities of employment in the graphic arts industry.

B. Initiate interest and advise students of educational requirements.

III. BEHAVORIAL OBJECTIVES:

A. Become familar with numerous areas of employment in graphic arts.

B. Students will be able to verbalize on the various opportunities in the areas of graphic arts.

IV. TIME: 1 Week

V. LESSON CONTENT:

A. Jobs in all parts of the country.

B. How to enter the field.

C. Educational requirements.

D. Completion of projects.

E. Student evaluation.

F. Clean-up and preparation for movement of capsule.

METALS

COURSE OF STUDY

METALS

Unit I

I. TITLE: Safety Related to Metals

II. PURPOSE:

A. To discuss safety as related to home and school.

B. To expose students to proper methods of handling tools and materials.

III. BEHAVIORAL OBJECTIVES:

A. Students will be able to relate safety at home.

B. Students will be able to use tools and materials in the metals unit safely.

IV. TIME: 1 Day

V. LESSON CONTENT:

A. Hand tools

1. Tools related to metals

B. Stationary tools

1. Floor Shear
2. Slip roll forming machine
3. Hydrolic shear
4. Box and pan brake
5. Diacro bender

C. Power tools

1. Buffer
2. Drill press
3. Grinder, pedestal
4. Lathe

D. Welding area

1. Oxygen-acetylene
2. Soldering furnace
3. Resistance welder
4. Arc welder

E. Foundry area

METALS

Unit II

I. TITLE: Steel Making

II. PURPOSE:

A. To explore steel making processes.

B. To explore iron ore refining.

C. To explore steel forming into useful shapes

III. BEHAVIORAL OBJECTIVES:

A. Students will be able to identify basic shapes of steel.

B. Students will learn about steel making processes.

IV. TIME: 3 Days

V. LESSON CONTENT:

A. Basic ingredients

1. Iron ore
2. Limestone
3. Coal

B. Refining coal

1. Coke
2. By-products

C. Blast furnace

1. "Charge"
2. Identification (size-shape-description)
3. Operation
4. Pig-iron
5. Slag

D. Pig iron processed

1. Open-hearth
2. Electric furnace
3. Oxygen furnace
4. Bessemer converter

E. Steel forming

1. Ingots
2. Blooms
3. Billets
4. Slabs

METALS

Unit II (Cont.)

F. Ferrous metals

Uses

METALS

Unit III

I. TITLE: Non-Ferrous Metals

II. PURPOSE:

- A. To explore the metals industry relating to non-ferrous metals.
- B. To experience the practical application of non-ferrous metals.

III. BEHAVIORAL OBJECTIVES:

- A. Students will learn basic production methods of non-ferrous metals.
- B. Students will be able to identify common non-ferrous metals and their uses.
- C. Students will learn working properties of a non-ferrous metal.

IV. TIME: 3 Days

V. LESSON CONTENT:

- A. Identification
    1. Brass
    2. Copper
    3. Aluminum
- B. Precious metals
    1. Gold
    2. Silver
    3. Platinum
- C. Industrial application
    1. Non-ferrous metals
    2. Precious metals
- D. Working properties of non-ferrous metals
    1. Hardness - softness
    2. Special handling
    3. Finishing
    4. Assembly

METALS

Unit IV

I. TITLE: Metal Forming by Bending

II. PURPOSE:

A. To explore the industrial principles of sheet metal forming.

B. To explore the purpose of seams, hems and notching-out.

C. To discover the role sheet metal processes play in:

1. The community
2. Industry
3. Construction

III. BEHAVIORAL OBJECTIVES:

A. The students, given a basic sheet metal design, will be able to indicate where and why a seam, a hem and notching-out is necessary.

B. The students will be able to relate the sheet metal industry to society.

C. The students will understand industrial principles of sheet metal forming.

IV. TIME: 5 Days

V. LESSON CONTENT:

A. Layout

1. Reading and understanding a blueprint
2. Transfer information to sheet stock
3. Identify hems, seams, notches

B. Sheet metal tools

1. Hand methods
2. Machine methods

C. Relating to enviornment

1. Occupations
2. Product identification (sheet metal)
3. Uses

D. Industrial processes

Discussion and description of methods and machinery

METALS

Unit V

I. TITLE: Forming Metal by Removal of Metal

II. PURPOSE:

- A. To explore various methods of metal shaping by removal of metal
- B. To discover the working properties of metals.
- C. To experience the shaping of metal by removal.

III. BEHAVIORAL OBJECTIVES:

- A. Students will be able to explain the function of the machine lathe and compare its operation to other machine tools.
- B. Students will be able to identify and relate products produced by machining to their everyday experience.
- C. Students will experience the removal of material by filing and with the use of a drill press.

IV. TIME: 5 Days

V. LESSON CONTENT:

- A. Industrial tools
    1. Lathe - demonstration
    2. Milling machines - discuss and describe
    3. Drill press
- B. Hand tools - compare to machine operation
    1. File
    2. Tap
    3. Die
- C. Product identification
    1. Identify products which have been machined
    2. Find out why machining is necessary

METALS

Unit VI

I. TITLE: Metal Forming by Change of State

II. PURPOSE:

A. To explore the process of casting.

B. To discover how casting is related to everyday living.

III. BAHAVIORAL OBJECTIVES:

A. The student will be able to identify the basic principles of sand casting.

B. The student will be able to identify objects relating to his surroundings formed by casting.

IV. TIME: 1 Day

V. LESSON CONTENT:

A. Tools

1. Pattern
2. Drag
3. Cope
4. Rammer
5. Sprue
6. Riser
7. Riddle
8. Molders tools

B. Foundry

1. Furnace
2. Crucible
3. Safety
4. Lifting tongs

C. Characteristics of Metal

1. Melting points
2. Uses of various metals
3. Expansion and shrinkage of metal

D. Relating to enviornment

1. Identification of cast products
2. Uses

METALS

Unit VII

I. TITLE: Metal Forming by Pressure

II. PURPOSE:

- A. To explore the process of forging.
- B. To experience the process of hand forging.

III. BEHAVIORAL OBJECTIVES:

- A. Students will be able to identify products formed by power forging.
- B. Students will be able to explain the advantages of drop forging.
- C. Students will understand the process of forging by "doing".

IV. TIME: 2 Days

V. LESSON CONTENT:

- A. History
    1. Hand forging
    2. Power hammers
- B. Hand forging tools
    1. Forging hammers
    2. Anvil
    3. Furnace
    4. Tongs
- C. Processes
    1. Drawing out
    2. Flattening
    3. Bending
- D. Power forge
    1. Hammer
    2. Dies
    3. Discussion of products made by forging
    4. Metal stresses

METALS

Unit VIII

I. TITLE: Fabrication (Mechanical)

II. PURPOSE:

A. To explore the various methods of metal fastening.

B. To experience the various methods of metal fastening.

III. BEHAVIORAL OBJECTIVES:

A. Students will be able to identify various methods of fasteners.

B. Students will be able to apply several methods of fastening metals.

IV. TIME: 1 Day

V. LESSON CONTENT:

A. Sheet metal screws

1. Type A sharp
2. Type Z blunt
3. Self tapping

B. Bolts

1. Stove bolts
2. Machine bolts
3. Machine screws
4. Nuts
5. Washers

C. Rivets

1. Flat head
2. Round head
3. Counter sunk

METALS

Unit IX

I. TITLE: Fabrication by Resistance, Fusion and Addition of Third Metal

II. PURPOSE:

A. To explore welding by resistance, fusion and addition of third metal.

B. To experience welding by resistance, fusion and addition of third metal.

C. To discover properties of various metals when heated.

III. BEHAVIORAL OBJECTIVES:

A. Students will be able to apply the principles of resistance, fusion and addition of metals to produce completed products.

B. Students will be able to relate and identify methods of fabrication to everyday living.

C. Students will be able to compare strength of various methods of fabrication by heat.

IV. TIME: 3 Days

V. LESSON CONTENT:

A. Resistance welding

1. Practical application
2. Advantages
3. Disadvantages
4. How it works - theory

B. Oxygen - Acetylne welding

1. Identification of equipment
2. Practical application - industrial applications
3. Fusion weld
4. Brazing
5. Addition of filler
6. Burning

C. Arc welding

1. Identification of equipment
2. Practical application
3. Industrial applications

D. Soldering

1. Hard soldering
2. Soft soldering

3. Application of methods
4. Tool and material identification

E. Relating methods of fastening metals

   1. Identification of methods used
   2. Deciding why a specific method is used

METALS

Unit X

I. TITLE: Finishing Process

II. PURPOSE:

A. To explore the various processes of decorative metal finishing.

B. To explore the processes of protective metal finishing.

C. To experience the application of a metal finish.

III. BEHAVIORAL OBJECTIVES:

A. Students will be able to select and apply decorative and protective finishes.

B. Students will be able to relate metal finishing processes to his daily experiences.

IV. TIME: 4 Days

V. LESSON CONTENT:

A. Metal finishing-school and home

1. Brush
2. Spray can
3. Dipping

B. Kinds of finishes

1. Undercoat
2. Protection
3. Plating

   Example: galvanizing

4. Decorative

C. Industrial processes - exploring

1. Plating
2. Dipping
3. Baking
4. Spraying
5. Epoxies

METALS

Unit XI

I. TITLE: Occupations Metal Working Industry

II. PURPOSE:

To explore occupations relating to the metals industry.

III. BEHAVIORAL OBJECTIVES:

A. Students will be able to identify several occupations in the metals industry.

B. Students will be able to identify several occupations in related industries.

IV. TIME: 1 Day

V. LESSON CONTENT:

A. Metals industry

1. Sheet metal
2. Machinists
3. Foundry
4. Forging
5. Furniture
6. Refining and steel production

B. Related industries

1. Aero space - rockets and missles
2. Teaching
3. Automotive
4. Shipping industry
5. Heating - airconditioning
6. Electronics
7. Construction

POWER MECHANICS

COURSE
OF
STUDY

POWER MECHANICS

Unit I

I. TITLE: Orientation

II. PURPOSE:

A. To acquaint the students with the laboratory, class procedures and expectations.

B. To provide the students with an overview of the class.

III. BEHAVIORAL OBJECTIVES:

A. Students will understand what is expected of them in this class.

B. Students will anticipate course offerings.

IV. TIME: One day

V. LESSON CONTENT:

A. Classroom Procedures

1. Introduction of teacher to the class
2. Expected conduct
3. Grading procedures
4. Testing procedures
5. Homework assignments
6. Class management

B. Overview of Course

1. Tour of laboratory
2. Reasons for study of Power Mechanics

POWER MECHANICS

Unit II

I. TITLE: General Safety Practices

II. PURPOSE:

- A. Acquaint students with the need for safety in the school shop.
- B. To equip the students with necessary safety practices.

III. BEHAVIORAL OBJECTIVES:

- A. Students will understand the need for using safe procedures in the shop.
- B. Students will be able to work safely in the shop.

IV. TIME: Three days

V. LESSON CONTENT:

- A. Need for safety
    1. Accidents occurring in the school shops
    2. Possible dangers in the shop
- B. Safety practices

POWER MECHANICS

Unit III

I. TITLE: Understanding Power

II. PURPOSE:

- A. To acquaint the students with the concept of power.
- B. To acquaint the students with the definitions of force, work, power and horsepower.

III. BEHAVIORAL OBJECTIVES:

- A. Students will be able to relate the concept of power to problems they will encounter in everyday life.
- B. Students will be able to identify force, work, power, and horsepower, and their application.

IV. TIME: Two days

V. LESSON CONTENT:

- A. Application of power
  1. Simple machines
  2. Various engines
  3. Power transmission and usage
- B. Definition of terms
  1. Force
     - a. Push or pull
     - b. The cause of motion
     - c. The total resultant energy applied in one direction
     - d. Example: weight, thrust, gravity
  2. Work
     - a. Moving an object a distance
     - b. Force is measured in feet
     - c. Distance is measured in feet
     - d. W = FXD - multiplying force times distance, the result is foot-pounds of work.
  3. Power
     - a. The rate of doing work
     - b. $P = \frac{W}{T} = \frac{FXD}{T}$
     - c. The amount of power developed is foot-pounds per second

4. Horsepower

   a. A unit of power
   b. One hoursepower is the power necessary to raise 33,000 pounds through a distance of one foot in one minute (33,000 foot-pounds per minute).
   c. Horsepower = $\frac{\text{foot-pounds} \quad \text{(work)}}{33{,}000 \times \text{time (minutes)}}$

POWER MECHANICS

Unit IV

I. TITLE: Simple Machines

II. PURPOSE:

- A. To explore the principles of manual power transmission.
- B. To explore the principles of mechanical advantages.
- C. To experience the practical application of manual power.

III. BEHAVIORAL OBJECTIVES:

- A. Students will be able to apply the mechanical advantage of the lever.
- B. Students will be able to apply the mechanical advantage of the pulley.
- C. Students will be able to apply the mechanical advantages of the inclined plane.

IV. TIME: Three days

V. LESSON CONTENT:

- A. Levers (Archimedes: "Give me a place to stand on. I will move the earth.")
  - 1. Terms
    - a. Fulcrum - pivot about which the lever turns.
    - b. Lever arm (LA) - distance from any force to fulcrum.
      L x LA = F x LA (load x lever arm = force x lever arm)
  - 2. Classes of levers:
    - a. First class - Example: crowbar
    - b. Second class - Example: Wheelbarrow
    - c. Third class - Example: Baseball bat
- B. Pulleys
  - 1. Fixed
    - a. No mechanical advantage
    - b. Only function to reverse the direction of the applied effort.
  - 2. Moveable

    Mechanical advantage based on number of suspensions.
- C. Inclined plane
  - 1. Wedge - 2 inclined planes
  - 2. Screw - modified inclined plane

POWER MECHANICS

Unit V

I. TITLE: Natural Sources

II. PURPOSE:

A. To explore possible natural sources for the transmission of power.

B. To discover means of harnessing resources.

C. To explore man-made sources for the transmission of power.

III. BEHAVIORAL OBJECTIVES:

A. Students will be able to identify natural sources for transmission of power.

B. Students will be able to put natural resources to a mechanical advantage.

IV. TIME: Two days

V. LESSON CONTENT:

A. Sources of power

1. Heat
2. Mechanical
3. Chemical
4. Electrical
5. Nuclear
6. Light or radiant

B. Natural power

1. Wind
2. Water
3. Steam

POWER MECHANICS

Unit VI

I. TITLE: External Combustion

II. PURPOSE:

- A. To explore the principles of external combustion.
- B. To discover and experience their application.

III. BEHAVIORAL OBJECTIVES:

- A. Students will be able to compare types of external combustion power.
- B. Students will be able to apply the principles of external combustion.

IV. TIME: Five days

V. LESSON CONTENT:

A. Explosives

1. Principles
2. Uses
3. Dangers
    - a. Radio controlled
    - b. Blasting caps

B. Steam Engines

1. Piston principle
2. Crankshaft precautions
3. Safety precautions
4. Operation
5. Testing horsepower
6. Experimental application

POWER MECHANICS

Unit VII

I. TITLE: Internal Combustion Power

II. PURPOSE:

A. To discover the principles of internal combustion.

B. To explore the application of internal combustion power

C. To develop understanding of the operation of internal combustion power.

D. To experience the maintainance required by internal combustion engines.

III. BEHAVIORAL OBJECTIVES:

A. Students will be able to demonstrate principles of internal combustion power.

B. Students will be able to compare application of types of internal combustion power.

C. To operate types of internal combustion power.

D. To understand the maintenance requirements.

IV. TIME: Twenty days

V. LESSON CONTENT:

A. Reciprocating engine

1. Four cycle

   a. Principle
   b. Operation
   c. Application
   d. Maintenance
   e. Trouble shooting

2. Two cycle

   a. Principle
   b. Operation
   c. Application

3. Diesel two cycle

   a. Operation
   b. Compare gas and diesel

B. Rotary combustion engine

1. Turbine

POWER MECHANICS

Unit VII (Cont.)

a. Operating principles
b. Comparison with internal combustion engine

2. Wankel

a. Principles
b. Operation
c. Possible application

C. Reaction engines

1. Solid fuel rocket

a. Principles
b. Application
c. Operation

2. Liquid fuel rocket

a. Principle
b. Application

3. Jets

a. Turbine comparison
b. Application

4. Action-reaction theory

POWER MECHANICS

Unit VIII

I. TITLE: Electrical Power

II. PURPOSE:

A. To explore the principles of electric power.

B. To discover the principles of electric power.

C. To explore the application of electric power.

III. BEHAVIORAL OBJECTIVES:

A. Students will demonstrate the electro-magnetic effect.

B. Students will conduct experiments with motor effect.

IV. TIME: Four days

V. LESSON CONTENT:

A. Magnet

1. Field of magnetism
2. Polarity

B. Electromagnetic

1. Current flow
2. Coil

C. Motor effect

1. Electromagnet
2. Opposition
3. Wiring coil
4. Bearings

POWER MECHANICS

Unit IX

I. TITLE: Application of Power in Our LIves

II. PURPOSE:

A. To explore the uses of power for transportation, production, recreation, and in the home.

B. To summarize the course

III. BEHAVIORAL OBJECTIVES:

A. Students will be able to apply the principles of power in the home.

B. Students will apply principles of power for transportation.

C. Students will explore principles of power in production.

D. Students will discuss principles of the application of power in the future.

IV. TIME: One day

V. LESSON CONTENT:

A. Transportation

1. Types of engines
2. Related problems

    a. Traffic
    b. Air pollution

3. Future possibilities

B. Power in the home

1. Light
2. Heat
3. Appliances

C. Production

1. Role of production in our homes and lives
2. Occupations
3. Future effect

D. Recreation

WOODWORKING

COURSE
OF
STUDY

WOODWORKING

Unit I

I. TITLE: Product Planning

II. PURPOSE:

A. To discover how good planning contributes to student project success.

B. To give student experience in selecting proper materials.

C. To demonstrate good design.

D. To emphasize the importance of wood working drawings.

III. BEHAVIORAL OBJECTIVES:

A. Students will be able to make up and follow steps of procedure.

B. Students will be able to identify the characteristics of woods.

C. Students will be able to figure board feet.

D. Students will know the fundamentals of good design.

IV. TIME: 5 Days

V. LESSON CONTENT:

A. Basic elements of design.

1. Proportion
2. Balance
3. Harmony
4. Rhythm

B. How to develop a step-by-step procedure for the project.

C. Wood identification.

D. Selecting woods suited to student projects.

WOODWORKING

Unit II

I. TITLE: Tool Maintenance

II. PURPOSE:

A. To experience proper ways of maintaining hand tools.

B. To experience proper method of maintaining machine tools.

III. BEHAVIORAL OBJECTIVES:

A. Students will be able to identify and use sharpening equipment.

B. Students will be able to maintain machine tools that they use in the woodshop.

IV. TIME: 6 Days

V. LESSON CONTENT:

A. Sharpening equipment

1. Advantages of using well maintained and sharp tools.
2. File, grinder, and whetstones of various types.

B. Hand tool sharpening

1. Hand planes, wood chisels, screwdriver bits, auger bits, and hand saws

C. Machine tool sharpening

Table saw blade and router bits

WOODWORKING

Unit III

I. TITLE: Fasteners

II. PURPOSE:

A. To familiarize students with different kinds and sizes of nails and screws.

B. To have students gain experience using nails and wood screws in the assembly process.

C. To acquaint students with different types of fasteners used in industry.

III. BEHAVIORAL OBJECTIVES:

A. Students will be able to identify screw and nail sizes.

B. Students will be able to select the proper fastener for the job.

C. Students will be able to compare the conventional shop methods of assembly with fasteners to light industrial techniques.

IV. TIME: 3 Days

V. LESSON CONTENT:

A. Nails

1. Uses of brad, finish and box nails.
2. Proper method of hammering nails.
3. Proper use of nail set

B. Screws

1. Types and sizes of screws
2. Proper tools

   a. Screwdriver
   b. Screw mates
   c. Counter sink

C. Special fasteners

1. Corregated fasteners
2. Corner fasteners

D. Special equipment

1. Yankee screwdriver
2. Reduction gear ratchet

E. Light industrial fastening methods

1. Nail guns
2. Staple guns

WOODWORKING

Unit IV

I. TITLE: Assembling Materials

II. PURPOSE:

- A. To familiarize students with the different types of clamps.
- B. To discover new ways to prevent warpage when clamping projects.
- C. To experience the various special clamping devices.

III. BEHAVIORAL OBJECTIVES:

- A. Students will use as many different clamps as possible on his project.
- B. Students will apply correct methods of checking his work for squareness and alignment.

IV. TIME: 3 Days

V. LESSON CONTENT:

- A. Common types of clamps, examples: C clamp, bar clamp, parallel clamp, miter clamp.
- B. Discuss accepted methods of clamping work.
  1. Use of the cross platen method of clamping
  2. Proper leveling techniques
  3. Alternating of the annualer rings to prevent warpage
  4. Use of the veneer press
- C. Basic methods of squaring and aligning projects.
  1. Diagonal measuring
  2. Corner squaring
  3. Leveling for flatness

WOODWORKING

Unit V

I. TITLE: Wood Laminating

II. PURPOSE:

- A. To explore how lamination construction is applied in industry.
- B. To discover the physical characteristics of lamination construction.
- C. To experience the process of lamination construction.

III. BEHAVIORAL OBJECTIVES:

- A. Students will be able to identify at least four different industrial uses of laminated material.
- B. Students will be able to identify four specific advantages of laminated materials over non-laminated materials.
- C. Students will be able to laminate wood stock.

IV. TIME: 5 Days

V. LESSON CONTENT:

- A. Industrial uses of lamination
  1. Laminated beams
  2. Furniture
  3. Sports equipment
  4. Plywood
- B. Advantages of lamination
  1. Strength
  2. Weight
  3. Beauty
  4. Resistance
- C. Application of the lamination process to projects.

WOODWORKING

Unit VI

I. TITLE: Wood Bending

II. PURPOSE:

A. To demonstrate two methods of bending wood.

B. To acquaint students with the proper equipment to use in bending wood.

C. To show students how to construct jigs for various types of bending.

III. BEHAVIORAL OBJECTIVES:

A. Students will be able to explain principles of bending wood with steam.

B. Students will be able to bend wood without heat.

C. Student will be able to plan and build his own wood bending jigs.

D. Students will be able to do simple wood bending with the aid of steam.

IV. TIME: 3 Days

V. LESSON CONTENT:

A. Most suitable woods for bending

B. Structural changes produced in wood by heat and moisture.

C. Dry bendings

1. Jigs needed
2. Equipment needed
3. Demonstrate bending

D. Steam bending

1. Steaming unit
2. Jigs used
3. Demonstrate steam bending

E. Student activity, Example: spoon or fork.

WOODWORKING

Unit VII

I. TITLE: Wood Joinery

II. PURPOSE:

A. To acquaint students with the five basic wood joints.

B. To familiarize the students with the proper tools for making wood joints.

C. To explore why more than one kind of wood joint is used.

III. BEHAVIORAL OBJECTIVES:

A. Students will be able to identify and construct the five basic wood joints.

B. Students will be able to apply use of tools in wood joint construction.

C. Students will be able to select a suitable wood joint for construction of his project.

IV. TIME: 8 Days

V. LESSON CONTENT:

A. Dowel joint

1. Strengths and weaknesses of the dowel joint
2. Equipment used in constructing dowel joint.
3. Method of construction
4. Student activities - using wood joints in project construction

B. Edge joint

1. Strengths and weaknesses of the edge joint.
2. Equipment used in constructing the edge joint.
3. Method of construction
4. Student activities - using wood joint in project construction.

C. Butt joint

1. Strengths and weaknesses of the butt joint
2. Equipment used in constructing the butt joint
3. Method of construction
4. Student activity - using wood joints in projects

D. Miter joint

1. Strengths and weaknesses of the miter joint
2. Equipment used in constructing the miter joint
3. Method of construction
4. Student activity - using wood joints in projects

E. Rabbet joint

1. Strengths and weaknesses of the rabbet joint
2. Equipment used in constructing the rabbet joint
3. Method of construction
4. Student activity - using wood joints in projects

WOODWORKING

Unit VIII

I. TITLE: Wood Finishes

II. PURPOSE:

- A. To familiarize the students with the equipment and materials used in finishing wood.
- B. To provide the students with experience in selecting finishes.
- C. To discover uses of fiberglassing for protection and beauty.
- D. To acquaint students with finishing room safety rules.

III. BEHAVIORAL OBJECTIVES:

- A. Students will be able to identify the proper brushes to use in finishing.
- B. Students will be able to apply oil stains, wood fillers, sealers, shellacs, varnish, and lacquer to their projects.
- C. Students will be able to identify such finishes as bleached wood and fiberglassing.
- D. Students will be able to apply safety rules pertaining to the finishing room.

IV. TIME: 7 Days

V. LESSON CONTENT:

A. Stains

1. Oil stain
2. Water stain
3. Spirit stain

B. Fillers

1. Why fillers are used
2. Two types of fillers

C. Sealers

1. Preparing sealers
2. Application of sealers

D. Finishes

1. Shellac
2. Varnish
3. Deft
4. Lacquer
5. Shoe polish
6. Oil finishes

WOODWORKING

Unit VIII (Cont.)

E. Rubbing out finish

1. Pumice, rotten stone
2. Waxing

F. Fiberglassing

1. Use as protective coating
2. Application procedures

WOODWORKING

Unit IX

I. TITLE: Woodworking Power Tools

II. PURPOSE:

A. To familiarize students with the proper safety rules.

B. To discover the different operation each machine is capable of doing.

C. To experience simple maintenance for each machine.

III. BEHAVIORAL OBJECTIVES:

A. Student will be able to relate verbally the safety rules before running power tools.

B. Students will be able to make his own setup on each machine.

C. Students will be able to apply basic maintenance necessary on a particular machine.

IV. TIME: One week

V. LESSON CONTENT:

A. Safety instruction

Band saw, drill press, disc sander, sabre saw, electric hand drill, router, belt sander, lathe, buffer and bench grinder.

B. Demonstrate safe operations of each machine (as above).

C. Verbal test on all safety rules - student must pass test before using power tools.

D. Maintenance

1. Proper oiling procedure
2. Checking of all running belts before each operation
3. Visual safety operations.

APPENDIX "E"

INTERIM EVALUATION REPORT

SAN JOSE STATE COLLEGE

INTERIM EVALUATION REPORT

TRANSPORTABLE INDUSTRIAL ARTS LABORATORIES

By

Daniel C. Lopez, Ed.D.
Ralph P. Norman, Ph.D.

January, 1969

San Lorenzo Unified School District
15510 Usher Street
San Lorenzo, California

SECTION I

INTRODUCTION

At the request of the San Lorenzo Unified School District, a study was made to evaluate the seventh and eighth grade industrial arts programs during part of May and June of 1966.

That study was funded as part of a Planning Grant under P.L. 89-10, Title III of the Elementary-Secondary Education Act, Project No. 66-993, Transportable Industrial Arts Laboratories.

The results of that study were presented to the San Lorenzo Unified District Board of Education which subsequently implemented the basic plan which became operational in early January of 1969.

This report is an interim report of progress toward meeting the stated goals which were suggested in the original survey under conclusions and recommendations.

CURRICULUM LIMITATIONS, 1966 STUDY

At the time the seventh and eighth grade industrial arts facilities were evaluated in May and June of 1966, certain limitations in the total program were noted. These were:

1. That seventh grade boys were being deprived of experiences with tools, machines, materials and industrial processes related to applied science and technology.

2. That because of the paucity of experiences related to industrial arts, seventh and eight grade boys in the district were deprived in attaining the limits of their potential.

3. That acceptable and worthy attitudes concerning the world of work, vocation and appreciations about industry were being slighted because of program limitations.

4. That the limited offerings of the San Lorenzo Unified School District industrial arts curriculum precludes poor articulation between the junior and senior high schools in the area of industry and technology.

Curriculum limitations in industrial arts at the time of the 1966 study were attributable to the impoverished financial situation of the district. With insufficient funds available for augmented physical plants, staff, equipment, tools and materials, there was little hope for improvement.

District planners were at that time evaluating innovative ideas which had the potential for alleviating the poverty offerings in industrial arts.

The survey team was of the opinion at that time, that the transportable capsule had merit for implementation. This capsule, along with a plan for curriculum development, had the possibility and probability for greatest success.

Accordingly, this plan was adopted by the Board; necessary pilot funding was procured, and the Transportable Industrial Arts Laboratories, funded under ESEA, Title III was implemented. Curriculum development and planning of facilities was part of the package.

SECTION III

AUGMENTED INTERIM PROGRAM EVALUATION, 1969

On January 15, 1969, the four junior high schools in the San Lorenzo District were visited by the evaluation team. While each of the schools, Barrett, Bohannon, Edendale, and Washington Manor Junior Highs are each unique in their physical plants, the augmented transportable capsules are one and the same, and the stationary parent laboratories are identical in each school.

Each stationary core is similarly equipped and designed so as to constitute a home base of operation in each school. The capsule, as it moves every nine weeks brings curriculum breadth and depth to the students.

In this interim assessment, the study team visited the physical plant of each new school facility assessing the flexibility and functional aspects of the offerings.

Students were observed in their work and planning stages and instructors were interviewed concerning their assessment of the units, the program, and student interest and participation.

The administrators of each school were interviewed and their reactions to the program were evaluated. In terms of the observations of students, facilities and program, the following conclusions are projected:

Curriculum and Instruction

1. It would appear that while transportable capsule facilities for industrial arts are not optimum in offerings and physical plant, that they do meet and exceed state minimum recommendations for industrial arts. It needs to be recognized that permanent facilities should form the basis for a sound program of industrial arts and that anything short of that represents an emergency need to a problem of enriched curriculum offerings.

2. The facilities in the form of transportable facilities compare well with those of many school districts in the state and in many ways exceed curriculum offerings in breadth and depth of many districts in the state.

3. The curriculum design originally drafted as the result of the 1966 study does not significantly differ from the one which we saw operational. Where changes and innovations have taken place, it has been in the best interest of the student.

4. The entire project idea appears to be an integral part of the total curriculum in each school. It should prevail as a means for continual growth and enrichment to students and should not be construed as an entity in itself. Because of the existence of these enriched offerings, students should articulate better with the high schools in the service area.

5. Students in each school where a capsule was operational appeared to be highly motivated and interested. None of the instructors appeared to be having any problems except that of trying to answer questions and keep pace with the enthusiasm of their learners. From an observable viewpoint, learning in a provocative and enriched environment was taking place. Conversations with students concerning the problems they were solving was indicative of behavorial change.

   Instructors and administrators in each school praised the interest and spontaneity of the learners as the result of the new augmented facilities.

Facilities and Physical Plant

1. From our observation, the observation of the administrators of each school, the instructors in charge of the capsules and district office coordinators, the mechanics of transportability, docking and becoming operational have exceeded planned expectations. Once the capsules have been docked and located, it is near impossible to detect that the capsule is not a permanent installation. The capsule blends in to the total stationary shop unit to make a functional industrial arts laboratory.

2. The facilities and equipment from the viewpoint of the teachers are conducive to good instruction. There are minor adjustments and relocations and reorientation of equipment that may take place, but this is within the realm of normal procedure. The survey team had no criticisms to make and was in accord with the favorable reactions received from students, teachers and administrators.

3. Transportable capsules from the considered opinion of the evaluators are serving a need for improved curriculum offerings, augmented experiences, and a plan which provides minimal instruction according to the state guide. In fact, as already stated, instruction, content and facilities exceed the minimal requirements.

   In generalizing beyond the San Lorenzo School District Project, it is feasible to suggest that prototype transportable units like those being used in San Lorenzo would find wide acceptance in other districts where flexibility is needed and budget paucity limits curriculum and physical plant expansion. This same kind of capsule--stationary laboratory unit could have applications in other areas such as business education, home economics and sciences.

It should be clearly understood, that where a school district has the capability to build permanent facilities which are representative of industrial arts broadened facilities, that this should be done!

Inservice and Re-Training of Staff

1. Those instructors who were part of the district before the capsule transportable units became activated appeared to be enthused over the results they were getting, and with the involvement they were part of during the pre-planning and inservice sessions. They feel that they have a personal identity with their capsule and felt challenged in terms of the varied student clientele with whom they worked. It was apparent that they were getting good supervision and constructive help from the district office.

   It was also noted by the evaluators that the instructors appeared to exhibit a "we" or team feeling with us, since the evaluators had worked closely with the staff during the various stages of the project.

   The two new instructors brought into the project were also as enthused as the instructors who were in on the initial venture and planning. They too exhibited a strong feeling of identification with the project.

Observations in General

1. It would appear to the evaluating team that this project has exceeded expectations. That capsule-transportable units have a valid and definite place in the instructional dynamic for industrial arts and other learning environments. The San Lorenzo School District is well launched on demonstrating that an exemplary program can be functional and challenging in capsule-transportable units.

2. It is too early in the history of this project to make suggestions for improvement at this time. All that was observed in the four schools in comparison to the 1966 findings is positive plus. It is hoped that pretest and post-test results at the close of the experimental phase, relative to behavorial changes, will be indicative of the significant growth that has taken place on the part of the learners.

3. It is our recommendation after evaluating the total project of Transportable Industrial Arts Laboratories in the San Lorenzo District that this project be continued and refunded so that adequate data can be accumulated from which to make evaluative inferences.

Were the project to be terminated at the end of this experimental period, the only assessments about its success would be based on invalid value judgments, we therefore, recommend its continuance with adequate fundings.

Daniel C. Lopez, Ed.D.
Professor

Ralph P. Norman, Ph.D.
Professor
Industrial Studies
San Jose State College
San Jose, California